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Arsenal, NJ 07806-5000.**

AUTHORITY

**US Army RDECOM-ARDEC, Attn: AMSRD-AAR-MEE
ltr dtd 16 Apr 2009**

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ORDNANCE TECHNICAL INTELLIGENCE AGENCY

ENCYCLOPEDIA OF EXPLOSIVES

**A Compilation of Principal Explosives,
Their Characteristics, Processes of
Manufacture, and Uses**

Best Available Copy

20060321014

**ORDNANCE LIAISON GROUP-DURHAM
Box CM, Duke Station
Durham, North Carolina**

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INTRODUCTION

The ENCYCLOPEDIA OF EXPLOSIVES was originally designed as an internal research instrument for use by personnel of the Ordnance Technical Intelligence Agency. At that time, the scope of the Encyclopedia included only explosives nomenclature and a brief statement of uses for each entry. Preliminary research, however, quickly revealed that unclassified publications in the explosives field were either outdated by the Second World War, or were too technical or too brief to be useful to the novice working with explosives data. The scope of the present Encyclopedia was determined by this gap in publications on explosives.

The Encyclopedia is intended to serve as a research and reference aid on domestic and foreign explosives, both industrial and military. It has been prepared as a preliminary edition with the hope that its users will readily contribute their suggestions, additions, and general improvements. These suggestions will be incorporated into a later final edition.

The main body of the Encyclopedia is divided into three sections: Glossary, General Section, and Foreign Section. In addition, there is an appendix and a bibliography.

The Glossary contains primarily those terms which either are unique to explosives or which have a particular specialized meaning when applied to explosives. Thus, terms such as "hygroscopicity" which do not change in meaning when describing explosives are omitted, while those like "power" which have a particular definition for explosives are included.

The General Section is intended to cover domestic and foreign standard explosives that are currently in use, or were in use during World War II. It also includes some explosive compositions which have been seriously considered for standardization by the United States in recent years. With few exceptions, the General Section does not include explosives components, raw materials, or related chemicals; these are covered in the appendix. Exceptions have been made for certain important materials (such as nitrocellulose) where it was felt that inclusion in the appendix would not permit adequate description. Each entry in the General Section includes (when information is available) a statement on American and foreign nomenclature, composition, characteristics, manufacturing processes, uses, and any other pertinent data.

The Foreign Section constitutes an index of foreign explosives nomenclature. It is subdivided into British, French, German, Hungarian, Italian, Japanese, Russian, and Spanish Terms. This section directs the user's attention to the appropriate entry in the General Section. It is hoped that a more extensive list of foreign terms can be provided in the future.

In addition to the main sections, the Encyclopedia contains two appendices. The first appendix provides a list of explosives constituents, with a brief statement on the uses of each. The second appendix consists of a tabulation of comparative test data for selected explosives to permit the user to compare certain properties of the listed explosives.

Finally, a bibliography has been prepared which provides the list of sources used in preparing the Encyclopedia.

The Encyclopedia was reviewed in draft form by interested personnel of Picatinny Arsenal, Dover, New Jersey. In particular, Dr. B. T. Fedoroff, Mr. O. E. Sheffield, and Mr. C. G. Dunkle very generously volunteered their time to correct the numerous errors and omissions in the draft.

R. P. A.
13 May 1960

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GLOSSARY

ABSORBENT

A porous material which may or may not be combustible and which has the ability to absorb a liquid explosive (such as nitroglycerin) in large quantities for the purpose of making the transport and handling of the explosive both safe and easy.

BLAST (or BLAST EFFECT)

The blast of a detonation is the shock wave emitted from the point of detonation, and includes a shock front, a high pressure area behind the shock front, and the following rarefaction. The energy released by the detonation of an explosive charge compresses the layer of air around the charge and forces it outward at high velocity. This layer of highly compressed air is bounded by an extremely sharp front known as the "shock front." The shock front is followed by a high pressure area composed of the gaseous products of detonation which move outward as a strong wind. Because of the forward inertia of the gaseous products of detonation, the pressure in the high pressure area cannot decrease in velocity as rapidly as the pressure at the point of detonation. Consequently, a low pressure area is produced, a "rarefaction," behind the high pressure area. When the pressure drops below the atmospheric pressure level, the wind of the high pressure area reverses its direction and moves toward the original detonation point. Thus, a target subjected to the blast of an explosive must undergo both a shattering shock front and pressures in two directions.

BRISANCE

The brisance of an explosive is the shock which is produced when the explosive detonates; that is, brisance is the shattering effect shown by an explosive, and depends principally upon the velocity of detonation of the explosive, and to a lesser extent upon its energy content.

CRATERING (or CRATERING EFFECT)

The ability of an explosion to move a quantity of earth and thus form a circular depression in the ground known as a crater. A ground-level explosion creates a crater by the scouring action of gases; an underground explosion creates a crater by the heaving action of the products of explosion.

DEFLAGRATION

The process of spontaneous surface burning or vaporizing, with the products of reaction flowing away from the surface to expose the unreacted material beneath. Each explosive has a certain temperature at which the output of heat is sufficiently high to permit burning or vaporization to continue without any additional heat from an outside source. At this temperature, which is called the "ignition temperature" (see entry), deflagration begins. Deflagration can proceed at different rates; in the case of a finely divided explosive, deflagration of all the particles can occur almost instantaneously. Confinement of the particles by the viscosity of gaseous products increases the pressure which in turn increases both the temperature and the rate of reaction. The final effect under confinement is explosion, which may be violent deflagration or detonation depending upon the material.

DENSITY OF LOADING

The density of loading of an explosive is the ratio between the weight of the explosive and the weight of the volume of water which would fill the total chamber in which the charge is loaded. It is used to determine the relative density of explosives loaded in containers such as projectiles and primers.

DESENSITIZER

A substance introduced into an explosive compound so as to reduce the explosive's sensitivity to initiation by impact, friction, heat, or by detonation of a primer.

DETONATION

The almost instantaneous decomposition of an explosive, either by an extremely rapid combustion or by rupture and rearrangement of the molecules themselves. The explosive reaction is initiated by the shock wave (see BLAST), and the reaction supplying energy to maintain the shock. A detonation can be visualized as an explosion wave travelling through the high explosive charge at an extremely high velocity (22,000 to 27,500 ft/sec). Detonation is the usual or desired manner of functioning of high explosives. Low explosives, or propellants, usually deflagrate (see entry) rather than detonate.

The rate of advance of the reaction zone is called the "detonation rate" or "detonation velocity." When the detonation rate attains such a value that it will continue without diminution through the unreacted material, it is called the "stable detonation velocity." When the detonation rate is equal to or greater than the stable detonation velocity, the reaction is called a "high-order detonation." When the detonation rate is lower than the stable detonation velocity, the reaction is called a "low-order detonation."

DETTONATION RATE OR DETONATION VELOCITY

See DETONATION

EXPLOSION

A violent bursting or expansion within a material which results from a chemical reaction, and which produces heat and noise, and may liberate gas. An explosion may be a deflagration or a detonation (see entries).

EXPLOSIVE

A substance capable of undergoing rapid chemical reaction or decomposition as described under EXPLOSION. Explosives may be classified in several ways depending upon the basis of comparison selected. When classified according to their characteristics of explosion, they may be divided into high explosives (H.E.) which detonate (including initiating and non-initiating explosives) and low explosives (L.E.) which deflagrate (see entries for HIGH EXPLOSIVES and PROPELLANTS). When classified according to chemical composition, they can be divided into organic compounds (including explosives such as nitroglycerin, nitrocellulose, TNT, tetracene), inorganic compounds (such as lead azide, ammonium nitrate, mercuric fulminate), and mixtures of oxidizing and oxidizable materials (such as black powder and some solid rocket propellants). When classified according to chemical composition they can also be divided into explosive compounds (products of chemical reactions between two or more substances) and explosive mixtures (products of the physical or mechanical mixture of two or more substances).

EXPLOSIVE TRAINS

A propelling-charge explosive train ejects the projectile from the weapon and usually consists of a primer, an igniter or igniting charge, and a propelling charge. Thus a spurt of fire from a small quantity of sensitive explosive, the primer, initiated by a blow from the firing pin, is transmitted and intensified by the igniter so that a large, relatively insensitive propelling charge burns in the proper manner and ejects the projectile from the bore.

A bursting-charge explosive train fragments the projectile, and usually consists of a primer, detonator, booster, and bursting charge. Other elements are sometimes required, but these four charges are fundamental. The detonator sets up a high explosive wave when initiated by the primer, which is intensified by the booster, and transmitted to the bursting charge, which then explodes with a high-order detonation.

EXTRUSION

The process or method by which certain explosives (principally solid propellants) are formed into comparatively intricate cross-sectional configurations by being forced through a die opening of the proper shape. Heat is usually applied to give added plasticity.

FORCE

See POWER

FUEL

The term, when applied to rocket propellants, indicates the material which, by burning, generates power (and thus the required thrust). The fuel generally is mixed with an oxidizer (see entry) to permit combustion. Fuels may be solid or liquid.

HIGH-ORDER DETONATION

See DETONATION

HIGH EXPLOSIVE (H.E.)

A material which normally detonates when subjected to heat or shock; it will not burn except under special conditions. High explosives are characterized by the extreme rapidity with which decomposition and blast occur. They decompose almost instantaneously either by extremely rapid combustion, or by rupture and rearrangement of the molecules themselves. In either case, gaseous and/or solid products of reaction are produced. The disruptive effect of the reaction makes a high explosive valuable as a bursting charge, but precludes its use as a propellant because the gases are formed so quickly that excessive pressures are developed which would likely burst the barrel of the weapon.

IGNITION TEMPERATURE

The minimum temperature of an explosive at which deflagration will begin within a specified time period, usually of five seconds. In the case of high explosives deflagration takes place so quickly as to produce a detonation.

INHIBITOR

A substance which is introduced into an explosive compound to stop or depress undesirable chemical reactions during storage, or to reduce the rate of chemical reaction upon explosion.

LOW EXPLOSIVE (L.E.)

See PROPELLANT

LOW-ORDER DETONATION

See DETONATION

MORAUPT EFFECT

See SHAPED CHARGE

MUNROE EFFECT

See SHAPED CHARGE

NEWTONIAN EFFECT

See SHAPED CHARGE

OXIDIZER

A substance which liberates oxygen and thereby permits the fuel with which it is mixed to burn. Oxidizers may be solid or liquid. Liquid oxidizers are stored separately from the fuel until combustion is desired. Solid oxidizers are incorporated into the explosive mixture.

POWER

The power, or strength, of an explosive is its ability to displace the surrounding medium.

PROPELLANT (LOW EXPLOSIVE, L.E.)

A combustible material which decomposes very rapidly but does not normally detonate (at high velocity), this action being called deflagration. In decomposition, propellants produce a large volume of gases which produce enough pressure to propel a projectile or rocket. Propellants do not usually propagate a detonation. Under certain conditions, however, they may react like high explosives, that is, they may detonate.

PRIMERS and PRIMER MIXTURES

A primer mixture is an explosive (called "initiating explosive") sensitive to a blow such as that from a firing pin. It is used to transmit shock or flame to another explosive, a time element, or a detonator. Primers can be classified as friction, percussion, or electric primers:

Friction primers are devices which produce a spit of fire as a result of friction of a rod or wire moving (either by push or pull) through the primer mixture. They are most commonly used for separate loading ammunition.

Percussion primers are devices which produce a spit of fire from the impact of a firing pin or from the impact of the percussion device in an inertia-operated fuse.

Electric primers are devices which are designed for initiation by an electric current. The electric and combination electric-percussion primers have largely supplanted the friction primers.

SENSITIVITY

Sensitivity to impact is the ease with which an explosive material explodes upon the application of mechanical shock. Explosion by impact may be due to the development in the explosive of "hot spots" of finite size. In general, the impact sensitivity of an explosive material increases with the temperature, and the molten material is much more sensitive than the hot, solid material.

Sensitivity to friction is the ease with which an explosive material explodes upon the application of friction. Explosion by friction, like explosion by impact, is generally attributed to hot spots within the explosive material. The friction-producing material must be of a certain degree of hardness and must have a melting point higher than the ignition temperature of the explosive.

Sensitivity to initiation is the ease with which an explosive material explodes when subjected to the explosion of another material. In general, sensitivity to initiation is parallel to sensitivity to impact, but not to sensitivity to friction (or heat).

SHAPED CHARGE

A shaped charge consists of a high explosive charge (usually cylindrical) into one end of which a cone has been sunk. The cone may or may not be lined with an inert material such as metal or glass, depending on whether the explosive charge is to be detonated upon direct contact with the target (no liner being used) or upon a specified distance from the target. The distance between the explosive and the target upon detonation is called the "stand-off" distance. When a shaped charge is detonated, detonation waves are formed which travel in different predetermined directions in such a manner that they meet and reinforce each other (much like light rays reflecting off a parabolic mirror). This reinforcing effect is called the "Munroe effect," after the man who discovered it. The reinforced detonation wave forms a rapidly-moving jet which contains in it small particles of the collapsing cone liner. The jet is followed by the "slug," which contains the major portion of the collapsing cone liner (the "Mohaupt effect" or Newman effect"). The major damage from a shaped charge detonation is caused by the jet, which exerts a pressure upon the target of several hundred thousand atmospheres, and which literally pushes aside the target material by plastic flow.

Shaped charges have been used in artillery and rocket ammunition, demolition charges, and antitank mines. While shaped charges may be used in both rotating and non-rotating projectiles, the rotation of a shaped charge projectile can reduce its effectiveness by as much as 50%. Rotating shaped charge projectiles are, however, more effective than a standard bursting charge. Shaped charge grenades and bazooka-type rockets do not rotate and have a resultant greater penetrating power on armor plate.

SHOCK WAVE

See BLAST

STABILITY

The ability of an explosive to retain unaltered its chemical and physical properties during a given period of storage, under normal conditions or sometimes under more severe conditions. Although explosives are by nature comparatively unstable in their structures, all military explosives may be considered to have a high order of stability at temperatures of from 15° to 25°C (59° to 77°F). Each explosive has a higher temperature at which decomposition becomes rapidly accelerated and instability is pronounced.

STABILIZER

A substance introduced into an explosive material for the purpose of increasing the explosive's ability to withstand spontaneous chemical decomposition. A stabilizer usually will react with the products of decomposition of the parent explosive and thereby will prevent these products from accelerating the decomposition rate.

STABLE DETONATION VELOCITY

See DETONATION

STAND-OFF DISTANCE

See SHAPED CHARGE

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STABLE DETONATION VELOCITY

See DETONATION

STAND-OFF DISTANCE

See SHAPED CHARGE

STRENGTH

See POWER

SYMPATHETIC DETONATION

Sympathetic detonation or explosion by influence is the explosion of a material produced by shock waves transmitted through the air from another explosion. This characteristic of certain explosives is commonly utilized in land mines.

ALMATRITE

AMATRITE

Alternate Nomenclature:

The entry is given in the English equivalent of the Russian nomenclature; there is no corresponding U.S. explosive.

Foreign Nomenclature:

Russian: Almatrit

Composition:

See specific compositions listed under AMMONIUM NITRATE NO. 98, KALI ALMATRIT NO. 55, and NATRI ALMATRIT NO. 19.

Comments:

Almatrites are a series of Russian commercial explosives, developed at the University of Moscow, which contain chlorates and perchlorates together with combustibles (organic compounds). They are reported to be as stable as, and less sensitive to friction than, cheddites.

AMATOL

See also AMMONIUM NITRATE, TRINITROTOLUENE

Alternate Nomenclature:

None

Foreign Nomenclature:

British: Amatol

French: Amatol

German: Amatol

Japanese: Shotoyaku

Italian: Amatolo

Russian: A, Amatol, AT

Spanish: Amatoia

Composition:

Amatols are compositions containing ammonium nitrate and TNT in varying ratios. The most common composition contains these ingredients in 50/50 proportions. Other common compositions contain ammonium nitrate and TNT in 80/20 and 60/40 ratios. 50/50 amatol uses Grade II TNT; 80/20 amatol uses Grade III TNT. (See TRINITROTOLUENE for details on the grades of TNT.)

AMATOL

Characteristics:

Amatols are buff yellow explosives. 50/50 amatol is melt-loaded, while 80/20 amatol is loaded by extrusion (see below under Manufacture). 50/50 amatol detonates when subjected to a temperature of 265°C for five seconds; 60/40 amatol detonates at 270°C and 80/20 amatol at 280°C. Upon detonation, 50/50 amatol emits black smoke; 80/20 amatol generates white smoke. Amatols do not form dangerous compounds with metals other than copper and tin. Amatols are more or less insensitive to shock and friction; increases in ammonium nitrate content decrease sensitivity. However, all amatols are hygroscopic, and increases in ammonium nitrate content increase hygroscopicity. Amatols have more strength than TNT, while 80/20 amatol is stronger than 50/50 amatol.

At temperatures under 80° to 81°C (melting point of TNT) TNT and ammonium nitrate do not react with each other; at temperatures of 100° to 120°C, these ingredients react only slightly. Sensitivity, strength, and stability are not affected by prolonged storage at 50°C.

Manufacture:

In the manufacture of 50/50 amatol, ammonium nitrate is dried and heated to 90°C. It is added to molten TNT. Mixing continues until the mixture cools to between 80° and 85°C, and the mixture is melt-loaded into shell or bomb. 80/20 amatol, although prepared in a like manner, is more difficult to manufacture since the mixture is plastic rather than fluid. The size of ammonium nitrate crystals must be controlled since large crystals will not retain molten TNT during the loading operation. Because of its plasticity, 80/20 amatol must be loaded with extrusion loading machines.

Uses:

Amatols have been used as the bursting charge in shell and bombs, mainly to conserve the limited supply of TNT. They also have been used in mixtures with aluminum to form ammonals (see entry).

Comments:

The only significant advantage of amatols has been the conservation (i.e., "stretching") of TNT supplies. The development of synthetic toluene manufacture has reduced this advantage. Moreover, the development of more powerful binary explosives, such as composition B and pentolite (see entries), has further contributed to lessened needs for amatols.

AMMONALMATTRIT NO. 98

AMERICAN

See PERMISSIBLE EXPLOSIVE

AMMONALMATTRIT NO. 98

See also ALMATTRITE

Alternate Nomenclature:
None

Foreign Nomenclature:

The entry is given in the Russian nomenclature; there is no English equivalent.

Composition:

Ammenium Chlorate---- 89%

Combustible----- 11% (containing 8% vaseline, 27% paraffin, 65% rosin)

Comments:

Ammonalmattrit no. 98 is a Russian commercial explosive of the almattrite class (see entry). Its brisance is higher than that of TNT.

AMMONAL

See also MINOL

Alternate Nomenclature:
None

Foreign Nomenclature:

French: Ammonal
German: Ammonal, Ammonpulver
Hungarian: Ammoniás robbanó-anyag
Italian: Ammonal
Russian: Ammonal
Spanish: Amonal

Composition:

Ammonals are compositions containing aluminum, ammonium nitrate, and TNT (i.e., amatol plus aluminum) in varying ratios. The composition listed below gives the most common proportions of these ingredients:

TNT----- 67%

Ammonium Nitrate---- 22%

Aluminum----- 11%

Some ammonals may also contain as much as 3% of charcoal.

AMMONAL

Characteristics:

Ammonals are cast-loaded explosives. The composition listed above will detonate when subjected to a temperature of 265°C for five seconds. Ammonals are more sensitive to initiation than amatols and, because of their aluminum content, detonate with higher temperatures, greater blast effect, and brighter flash. The composition given above is about 12% more brisant than 50/50 amatol and practically as brisant as TNT (99.6% as brisant as measured by the Sand Test).

Manufacture:

See AMATOL

Uses:

Ammonals have been used in shell to conserve the limited supply of TNT (see Comments below). Although they are no longer used as standard explosives, the high flash of an ammonal burst is useful in proving ground tests to facilitate observation, particularly at night.

Comments:

The only significant advantages of ammonals have been the conservation of TNT supply and the higher brisance over amatols (which also have been used to conserve TNT). The development of synthetic toluene manufacture has reduced these advantages. Moreover, since ammonals are inferior to minol (see entry) with respect to blast and shock effects and less brisant than more modern binary explosives such as pentolite and composition E (see entries), they offer no advantages for use in connection with modern techniques of warfare.

AMMONIA DYNAMITE

See STRAIGHT DYNAMITE

AMMONIA GELATIN DYNAMITE

See GELATIN DYNAMITE, LOW-FREEZING
AND NON-FREEZING DYNAMITES

AMMONITE

AMMONITE

Alternate Nomenclature:

None

Foreign Nomenclature:

French:	Ammonite
German:	Ammonit
Italian:	Ammonite
Russian:	Ammonit
Spanish:	Amonita

Composition:

Ammonites are a group of safety (permissible) explosives, now used primarily in the Soviet Union, which contain ammonium nitrate plus nitro compounds. The following compositions can be considered as being representative of Soviet types:

Ammonium Nitrate---- 88%
TNT----- 12% (known as ammonit no. 2)

Ammonium Nitrate---- 73%
Potassium Nitrate--- 15%
TNT----- 12%

Ammonium Nitrate---- 77.6%
TNT----- 10.4%
Wood Meal----- 4.0%

Ammonium Nitrate---- 54.5% to 57.5%
TNT----- 8.5% to 9.5%
Pine Bark----- 2.5% to 3.5%
Sodium Chloride---- 31.0% to 33.0%

Ammonium Nitrate---- 59.5% to 62.5%
Trinitroxylenene---- 9.5% to 10.5%
Pine Bark----- 2.5% to 3.5%
Sodium Chloride---- 25.0% to 27.0%

Other aromatic nitro compounds such as dinitronaphthalene may be used in place of TNT and trinitroxylenene.

Characteristics:

Ammonites have a low sensitivity to both shock and friction because of their ammonium nitrate content. This ammonium nitrate, however, makes them extremely hygroscopic. Moreover, they will deteriorate when stored for any length of time.

Manufacture:

Ammonites are mechanical mixtures and are made simply by mixing ingredients together in the same manner as most dynamites.

AMMONITE

Uses:

Ammonites are used for underground mining where a permissible explosive is required. Their use is confined primarily to the Soviet Union. Some ammonites have been employed in military roles as substitutes for explosives using TNT and nitroglycerin.

AMMONIT-GUDRONIT

Alternate Nomenclature:

None

Foreign Nomenclature:

The entry is given in the Russian nomenclature; there is no English equivalent.

Composition:

Ammonium Nitrate---- ?
Tar (Gudron)----- ? The exact composition is not known.

Comments:

Ammonit-gudronit is a Russian commercial blasting explosive, probably of the ammonite class (see entry). Its brisance is about equal to that of TNT. Because of its ammonium nitrate content, ammonit-gudronit is hygroscopic, and will probably deteriorate upon long storage.

AMMONIUM CRESSYLATE

See ECRASITE

AMMONIUM NITRATE

Alternate Nomenclature:

None

Foreign Nomenclature:

French:	Nitrat d'ammoniaque
German:	Ammoniumnitrat, Ammoniumsalpeter
Hungarian:	Ammoniumnitrát. Ammonsálfstrom
Italian:	Nitrato ammonico
Japanese:	Ammō-nī-ku
Polish:	Sałטרה amonowa
Russian:	Аммиачная селитра, Азотно-кислый аммоний
Spanish:	Nitrato amónico

AMMONIUM NITRATE

Composition:

NH_4NO_3 --- chemical compound containing the following percentages by weight of the elements: Nitrogen----- 35.00%
Hydrogen----- 5.04%
Oxygen----- 59.96%

Characteristics:

Ammonium nitrate is a colorless, press- or cast-loaded explosive melting at 169.5°C . It will ignite when subjected to a temperature of 465°C for five seconds. The grade used for explosives must be at least 99% pure. Ammonium nitrate is extremely hygroscopic. In the presence of moisture, it will react with copper to form a compound (tetraminocupric nitrate) which is as sensitive to impact and as brisant as lead azide. Ammonium nitrate will corrode iron, steel, brass, lead, and cadmium. It is the least sensitive to impact of any of the military explosives. It will not detonate when subjected to heat unless highly confined, and only partial detonation results even when boosted with a charge of tetryl or cyclonite. Despite its hygroscopicity, ammonium nitrate is very stable in storage at temperatures as high as 150°C (although slight sublimation may occur under certain conditions). Decomposition does not occur significantly until the compound begins to melt.

Manufacture:

An aqueous solution of ammonia is neutralized with nitric acid and then evaporated. The resulting ammonium nitrate is grained and dried.

Uses:

Ammonium nitrate is commonly used as an explosives extender (e.g., amatol), and as an ingredient in binary explosives, dynamites, cratering explosives, and some solid rocket propellants. Because of its insensitivity, ammonium nitrate is seldom used alone as an explosive.

Comments:

Ammonium nitrate is used universally both as a nitrogenous fertilizer and as a constituent in explosives. When used as a fertilizer, the compound does not have to meet as high a standard of purity as that imposed by explosives requirements. Facilities used to produce ammonium nitrate fertilizer can produce the purer grade for explosives use without any conversion. The purity of the product can be improved by controlling the purity of the ammonia and nitric acid.

In 1968, an agreement was concluded among the several NATO member nations for a common minimum specification on ammonium nitrate applicable to deliveries of the explosive material from one NATO country to another.

AMMONIUM PICRATE

AMMONIUM PICRATE

See EXPLOSIVE D

AMMONIUM TRINITROPHENOLATE

See EXPLOSIVE D

AMMONPEK

Alternate Nomenclature:

None

Foreign Nomenclature:

The entry is given in the Russian nomenclature; there is no English equivalent.

Composition:

Ammonium Nitrate---- 95%
Coal Tar Pitch----- 5%

Comments:

Ammonpek is a Soviet high explosive which has been used as a substitute for TNT. It has the advantage of low sensitivity to shock, but because of its high ammonium nitrate content, it is extremely hygroscopic and is probably unstable in storage. The development of synthetic toluene manufacture probably has greatly decreased the need for ammonpek.

ANGAYAKU

Alternate Nomenclature:

None

Foreign Nomenclature:

The entry is given in the Japanese nomenclature; there is no English equivalent.

Composition:

Japan has used three types of angayaku, with the following compositions:

Cyclonite-----	25%	85%	42%
Ammonium Nitrate-----	75%	...	...
PETN-----	...	...	50%
Wax-----	...	15%	8%

ANGAYAKU

Comments:

Cyclonite/wax angayaku is similar in composition to U.S. composition A (see entry). It was used by the Japanese during World War II as a bursting charge for armor-piercing shells; while cyclorite/ammonium nitrate angayaku was used in bombs and cyclonite/PETN/wax angayaku was used in machinegun bullets.

NOTE: The Japanese incorporated high explosive fillers into machinegun bullets with calibers as small as 7.7-mm.

APACHE COAL POWDER

See PERMISSIBLE EXPLOSIVE

ARABINOSE TETRANITRATE

See SUGAR NITRATE

AROMATIC NITRO COMPOUNDS

See also EXPLOSIVE D, PICRIC ACID, TETRANITROANILINE, TETRYL, TRIAZIDO-TRINITROBENZENE, TRINITROPHENETOLE, TRINITROTOLUENE; also Appendix I under CRESSYLITE, DINITROBENZENE, DINITRONAPHTHALENE, DINITROPHENOL, DINITROTOLUENE, DINITROXYLENE, HEXANITRODIPHENYLAMINE, MONONITROBENZENE, MONONITRONAPHTHALENE, MONONITROTOLUENE, TRINITROBENZENE, TRINITRONAPHTHALENE, TRINITROXYLENE

Alternate Nomenclature:

Aromatics

Composition:

For specific comments on Composition, Characteristics, Manufacture, and Uses, see EXPLOSIVE D, PICRIC ACID, TETRANITROANILINE, TETRYL, and TRINITROTOLUENE.

AROMATIC NITRO COMPOUNDS

Characteristics:

Aromatic nitro compounds form the most important class of military high explosives. They include the many nitro derivatives of benzene, toluene, xylene, naphthalene, phenol, and cresol (other aromatic nitro compounds such as anthracene are not utilized in explosives). As a group, these nitro compounds are stable and efficient in explosives. They are, however, poisonous, and care must be taken in their handling and manufacture. They can be absorbed through the skin and by breathing their dust and vapors. Various illnesses ranging from temporary mild dermatitis to death can result.

Manufacture:

In the manufacture of aromatic nitro compounds, the product is always obtained by reacting the aromatic compound with nitric acid. The aromatic compounds are obtained either as by-products in the manufacture of coke or gas, or in gasoline as a product of the fractional-distillation process.

Uses:

Aromatic nitro compounds have a wide range of uses, both alone and as constituents of compound explosives. For example, TNT (trinitrotoluene) and picric acid (trinitrophenol) have been used alone as bursting charges for high explosive ammunition; in addition, TNT has been used in amatols and picric acid has been used in the manufacture of explosive D. TNT still is the most widely used of the standard military bursting charges. Aromatic nitro compounds also have been used as constituents in smokeless propellants, in detonating and priming compositions, and in liquid form (usually as by-products in the manufacture of pure nitro compounds) in non-freezing dynamites and other commercial explosives.

AROMATICS

See AROMATIC NITRO COMPOUNDS

ASTRALITE

See also DYNAMITE

Alternate Nomenclature:

None

Foreign Nomenclature:

British:	Astralite
French:	Astralit
German:	Astralit
Italian:	Astralite
Spanish:	Astralita

ASTRALITE

Composition:

Astralites are a form of ammonium nitrate dynamites. Two examples, manufactured in pre-World War II Germany, are given below:

	Astralit	Astralit IA
Ammonium Nitrate-----	80%	68.3%
TNT-----	12%	25.0%
Vegetable Meal-----	3%	2.7%
Charcoal-----	1%	...
Nitroglycerin-----	4%	4.0%

The British astralite contains nitrocellulose (guncotton type) in place of the vegetable meal.

Characteristics:

Astralites differ from most dynamites in that they contain only small amounts of nitroglycerin and relatively large amounts of TNT. Their other characteristics are those listed under DYNAMITE.

Manufacture:

See DYNAMITE.

Uses:

Astralites are used for rock-blasting work. They have found wide use in the Communist Bloc, especially in the Soviet Union.

AUSTIN RED-D-GEL

See PERMISSIBLE EXPLOSIVE

AUSTIN RED DIAMOND

See PERMISSIBLE EXPLOSIVE

AZIDES

See also LEAD AZIDE, SILVER AZIDE

Comments:

Azides are compounds of hydrazoic acid (HN_3) and are explosive in their nature (especially the azides of lead, mercury, and silver). Azides contain no oxygen in their chemical structure and their decomposition does not involve combustion. Lead azide has been used extensively in explosives applications.

AZIDO-TENEROSSOVAYA

AZIDO-TENEROSSOVAYA

Alternate Nomenclature:
None

Foreign Nomenclature:
The entry is given in the Russian nomenclature; there is no English equivalent. The literal translation of the term is "of lead azide and lead styphnate."

Composition:

Lead Azide----- 0.20 to 0.25 gram
Lead Styphnate---- 0.06 to 0.05 gram layer covering lead azide

Comments:

Azido-tenerossovaya is a Soviet composition used in detonating caps.

BALLISTITE

See also DOUBLE-BASE SMOKELESS PROPELLANT, NITROCELLULOSE

Alternate Nomenclature:
None

Foreign Nomenclature:
French: Balistite
German: Ballistit, WPC/89,
Würfelpulver/89
Hungarian: Ballisztit
Italian: Balistite
Spanish: Balistita

Composition:

A typical composition is listed below. Percentages may vary depending upon the manufacturer and the end-use of the product.

Nitrocellulose----- 60%
Nitroglycerin----- 39%
Diphenylamine----- 0.75%
Graphite Coating--- 0.25%

Characteristics:

Ballistite generally appears in flakes, sometimes in cords and single-perforated tubes. Its other characteristics are those listed for double-base smokeless propellant. (see entry).

Manufacture:

See DOUBLE-BASE SMOKELESS PROPELLANT

BALLISTITE

Comments:

In the United States, ballistite is the standard mortar round propellant. The term "ballistite" often is used in the United States as a generic term for smokeless propellants with a high nitroglycerin content. In Italy, Germany, and the Scandinavian countries, ballistite has been the preferred propellant for most types of ammunition. In Japan it has been used to fill rockets.

BARATOL

Alternate Nomenclature:

None

Composition:

Barium Nitrate-----	67%
TNT-----	33%

Characteristics:

Baratol is a cast-loaded high explosive. It will ignite when subjected to a temperature of 385°C for five seconds. Baratol is nonhygroscopic at 30°C and 90% relative humidity. It is considerably less sensitive to impact than TNT, and is about 56% as brisant as TNT.

Manufacture:

Barium nitrate is heated to about 90°C and is added to molten TNT. The mixture is agitated until uniform. It is then melt-loaded at the lowest practicable temperature.

Uses:

Baratol has been used as a bomb filler.

Comments:

Baratol was first developed during World War I. The proportions given under Composition above are not mandatory and can be varied to meet required purposes.

BARONAL

BARONAL

Alternate Nomenclature:

None

Composition:

Barium Nitrate----- 50%
TNT----- 35%
Aluminum----- 15%

Characteristics:

Baronal is a cast-loaded high explosive somewhat similar to baratol (see entry). It will ignite when subjected to a temperature of 345°C for five seconds. Baronal is less sensitive to impact than TNT, and is about 83% as brisant as TNT. It is more brisant than baratol.

Manufacture:

Barium Nitrate is heated to about 90°C and is added to TNT which has been previously melted. Powdered aluminum is added, and the mixture is agitated until uniform. Baronal is then melt-loaded at the lowest practicable temperature.

Uses:

Baronal has been used as a bomb filler.

BELAYA SMES'

Alternate Nomenclature:

None

Foreign Nomenclature:

The entry is given in the Russian nomenclature; there is no English equivalent. The literal translation of the term is "white composition."

Composition:

Mercuric Fulminate----- 80 to 85%
Potassium Chlorate----- 15 to 20%

Comments:

'Belaya smes' is a Soviet mixture used in percussion compositions.

BELLITE

BELLITE

Alternate Nomenclature:
None

Foreign Nomenclature:
Russian: Belit

Composition:

Bellites are a series of commercial high explosives containing ammonium nitrate and nitro compounds, principally of benzene. The original formula called for ammonium nitrate and mononitrobenzene. This benzene compound was later replaced by dinitrobenzene which, because of its solid structure and greater effectiveness, was found to produce a better explosive. The following compositions, used by the Soviet Union, may be taken as representative:

Ammonium Nitrate-----	35%	-----	87%	-----	80%
Dinitrobenzene-----	65%	-----	13%	-----	8%
Trinitroxylen-----	...	-----	...	-----	12%

Comments:

Bellites are used primarily for coal mining. They are popular in Europe and in the Soviet Union, but have not met with much favor in the United States.

BITUMINITE

See PERMISSIBLE EXPLOSIVE

BLACK DIAMOND

See PERMISSIBLE EXPLOSIVE

BLACK DIAMOND NU-GEL

See PERMISSIBLE EXPLOSIVE

BLACK POWDER

BLACK POWDER

Alternate Nomenclature:
Gunpowder

Foreign Nomenclature:

French:	Poudre noire
German:	Schwarzpulver
Hungarian:	Fekete lópor
Italian:	Polvere nera
Russian:	Chörnyi porokh
Spanish:	Polvora negra

Composition:

Potassium or Sodium Nitrate----	75%)
Charcoal-----	15%) approximate
Sulfur-----	10%)

Characteristics:

Black powder is a gray-black to black, press-loaded (or loosely packed) explosive. It will ignite when subjected to a temperature of 427°C for five seconds. It is insensitive to shock but highly sensitive to friction and heat. It is only about 50% as strong as TNT, being the weakest explosive used as a bursting charge. Black powder is hygroscopic, and is therefore unstable in storage except under conditions of controlled humidity. It will not burn completely and the residue causes excessive corrosion of the gun barrel and produces large quantities of smoke.

Uses:

Black powder may be used in primers, igniters, shrapnel charges, safety fuse, quick matches, and rarely, in bursting charges for low explosive shells. During World War II, the Soviet Union used two principal types of black powder: "melkozernisty" (grains of about 1-mm) and "krupnozernisty" (grains of about 5- to 10-mm). These were used in some igniters, delay fuses, and in incendiary, illuminating, shrapnel, and propaganda ammunition.

Manufacture:

Sulfur of very high quality is pulverized together with charcoal, in the specified proportions. The pulverized material is then mixed either with the pulverized nitrate (also of very high quality) or stirred into a saturated solution of the nitrate (depending upon plant equipment). The product is ground, pressed, and re-ground to insure uniformity.

Black powder also has been used in countries such as France as a cheap blasting explosive for commercial purposes. For such uses, France has produced three varieties of black powder:

	<u>Lente</u>	<u>Ordinaire</u>	<u>Forte</u>
Salt peter (sodium or----- potassium nitrate)	40%	62%	72%
Charcoal-----	30%	18%	15%
Sulfur-----	30%	20%	13%

Comments:

The military applications of black powder have practically disappeared due to the development of more efficient explosives. Black powder containing potassium nitrate is called "Army Black Powder;" black powder containing sodium nitrate is called "commercial" or "sodium nitrate" black powder.

BLASTING GELATIN

See also DYNAMITE, NITROGLYCERIN

Alternate Nomenclature:
Explosive Gelatin

Foreign Nomenclature:

French:	Gélatine explosive, Gélatine détonante
German:	Sprenggelatine, Sprenggummi
Hungarian:	Robanó-zselatin
Italian:	Gelatina esplosiva
Japanese:	See DYNAMITE
Russian:	Gremuchii studen'
Spanish:	Galatina explosiva, Galatina detonante, Dinamita goma

Composition:

Nitroglycerin-----	90 to 93%
Nitrocellulose-----	7 to 10%

BLASTING GELATIN

Characteristics:

Blasting gelatin is a yellow, translucent, soft, elastic explosive material. It is less sensitive to shock, friction, and impact than either nitroglycerin or guhr dynamites (dynamites with inactive base). "Thinner" gelatins (those utilizing smaller quantities of nitrocellulose) are known as "gelatin dynamites" (see entry). Blasting gelatin is completely insensitive to water, and is far more difficult to freeze than guhr dynamites. However, when it does freeze, its sensitivity increases markedly. Blasting gelatin is about as stable as nitroglycerin; it is completely stable at ordinary temperatures. Rapid temperature changes, however, cause the nitroglycerin to exude and result in increased sensitivity. Blasting gelatin is difficult to explode, the rate of difficulty increasing with increases in nitrocellulose content. A high nitrocellulose content changes the explosive characteristics from those of a high explosive to those of a propellant (see DOUBLE-BASE SMOKELESS PROPELLANT).

Manufacture:

Nitrocellulose (collodion cotton type) is mixed into nitroglycerin for the preliminary gelatinization. The resulting colloid is mixed by shovel or by hand and is allowed to stand for some 20 to 25 minutes. It is then sent to mixing machines, where the absorbents are incorporated into the colloid. The gelatin is then placed into cartridges by means of screw machines.

Uses:

The high brisance of blasting gelatin is used to best advantage for the blasting of very hard rock. It is also excellent for use in underwater blasting operations.

BULK POWDER

See E. C. POWDER

CARLIT

Alternate Nomenclature:
None

Foreign Nomenclature:
Japanese: Karitto

Composition:

Ammonium Perchlorate	56%
Silicon Carbide	16%
Wood Pulp	12%
Petroleum	6%

Comments:

Carlit is a Japanese explosive composition which was first used during World War II as a bursting charge for mines and depth charges, and in demolition charges, primarily to conserve the limited supplies of benzene and toluene. At present, it is used extensively in Japan for industrial purposes, and is being utilized in experimental solid rocket propellants. Since the first carlit composition (listed above), several modifications have been produced.

CELLULOSE NITRATE

See NITROCELLULOSE

CHANAYAKU

Alternate Nomenclature:
None

Foreign Nomenclature:

The entry is given in the Japanese nomenclature; there is no English equivalent.

Composition:

TNT-----	70%
Dinitronaphthalene-----	30%

Comments:

Chanayaku is a Japanese explosive composition which was used during World War II as a bursting charge for artillery ammunition.

CHAÖYAKU

Alternate Nomenclature:
None

Foreign Nomenclature:

The entry is given in the Japanese nomenclature, there is no English equivalent.

Composition:

Picric Acid-----	75%
TNT-----	25%

Comments:

Chäöyaku is a Japanese explosive composition which was

CHĀYAKU

used during World War II as a bursting charge for aerial bombs.

CHEDDITE

Alternate Nomenclature:
None

Foreign Nomenclature:
French: Cheddite
German: Cheddit
Hungarian: Cheddit
Italian: Cheddite, Alto esplosivo
al clorato di potassio
(potassium chlorate high
explosive)
Russian: Shedit
Spanish: Cheddita

Composition:

Cheddites are a series of chlorate (and sometimes perchlorate) explosives. The two types given below, manufactured in France, may be considered representative:

	<u>Cheddite No. 1</u>	<u>Cheddite No. 4</u>
Potassium Chlorate	... 79%	79%
Sodium Chlorate	79%	...
Castor Oil	5%	5%
Mononitronaphthalene	...	1%
Dinitrotoluene	15%	15%

Characteristics:

Cheddites are more sensitive than the permissible explosives, and the chlorate cheddites are more sensitive than the perchlorates. The lower sensitivity of the perchlorates makes them the safer cheddites to handle and transport.

Uses:

Cheddites are widely used for commercial blasting purposes. They are used in France for both industrial and military blasting operations.

Comments:

Cheddites were developed in France. They have, however, been adopted by many countries. The Soviet Union has not used them since the country feels that its aluminites (see entry) are preferable.

COAL TAR SALT

COAL TAR SALT

See TRINITROTOLUENE

COALITE

See PERMISSIBLE EXPLOSIVE

COLLIER

See PERMISSIBLE EXPLOSIVE

COLLODION

See PERMISSIBLE EXPLOSIVE

COLLOIDED PROPELLANT

See SMOKELESS PROPELLANT

COMPOSITE PROPELLANT

Alternate Nomenclature:
None

Composition:

Composite propellants contain no nitrocellulose or nitroglycerin (as do other types of modern propellants). They normally consist of an organic fuel (such as ammonium picrate), an inorganic oxidizing agent (such as potassium nitrate), and an organic binding agent. A representative composition, known as T-9, is given below:

Ammonium Picrate-----	40.7%
Potassium Nitrate-----	49.0%
Ethyl Cellulose-----	4.5%
Chlorinated Wax-----	4.5%
Calcium Stearate-----	0.5%

COMPOSITE PROPELLANT

Characteristics:

Composite propellants are an uncolloided heterogeneous mixture of ingredients. They are more or less plastic, and can be molded into the desired shape. Their burning rate is not affected by low temperatures, but they tend to become brittle and crack. They cannot be used with safety at temperatures of -12°C and under. The burning of composite propellants produces a large amount of white smoke.

Manufacture:

The manufacturing process involves only a simple mixing of the ingredients.

Uses:

Composite propellants are used as JATO (Jet-Assisted Take-Off) and rocket propellants.

Comments:

Composite propellants were developed primarily to eliminate the difficulties involved in the manufacture of double-base propellants in large grains, and the changes in ballistic effects of these double-base propellants caused by changes in temperature. Composite propellants have been successful in these respects, although they are still affected by low temperatures. Further improvements in resistance to temperature changes will be made as better binding agents are developed.

COMPOSITION A

Alternate Nomenclature:

None

Composition:

Cyclonite-----	91%
Beeswax or wax derived from petroleum-----	9%

Characteristics:

Composition A is a white to buff (although German and Italian compositions were dyed blue and red respectively), press-loaded explosive. It will detonate when subjected to a temperature of 250°C for five seconds. Composition A is about 30% stronger than TNT. It is entirely stable but is slightly corrosive to steel, magnesium, copper, and copper alloys. The wax reduces the composition's sensitivity. However, the wax does not enter into detonation and therefore reduces velocity. In burning, the wax also robs the explosive of some oxygen, thereby reducing its strength.

COMPOSITION A

Uses:

Composition A is best used as a booster with small amounts of wax, which does not coat the grain. It is also used as a bursting charge, where larger amounts of wax are used to act as grain coating.

Comments:

Changes in the granulation of cyclonite and the method of manufacture have resulted in variations known as composition A-2 and composition A-3. A similar composition, called "angayaku" (see entry), was used by Japan during World War II.

COMPOSITION A-2 and COMPOSITION A-3 See Comments under COMPOSITION A

COMPOSITION B and COMPOSITION B-2

Alternate Nomenclature: Cyclotol

Foreign Nomenclature:

Italian: Tritolite
Japanese: Nigotanyaku
Swedish: Hexotol (Brand name used by Bofors of Sweden)

Composition:

Cyclonite-----	59%	}
TNT-----	40%	}
Beeswax-----	1%	

U.S. composition B

Cyclonite-----	50%	}
TNT-----	50%	}

Foreign composition B

Cyclonite-----	60%	}
TNT-----	40%	}

Composition B-2

Characteristics:

Compositions B and B-2 are dirty white to brownish yellow, cast-loaded explosives. Composition B will detonate when subjected to a temperature of 278°C for five seconds. It is slightly corrosive to steel, magnesium, copper, and copper alloys. Compositions B and B-2 are very stable with respect to temperature. Composition B-2 is much more sensitive than composition B. Both are better than composition A in that an active desensitizing agent increases power. However, sensitivity and TNT content are disadvantages (the latter because it may be in limited supply).

COMPOSITION B, B2

Manufacture:

Wet cyclonite is slowly added to TNT which has been previously melted at 100°C. The mixture is heated and stirred until all moisture has been removed. Wax is added and the mixture is thoroughly stirred. It is then cooled to a suitable pouring temperature.

Uses:

Composition B is used by all nations as a bursting charge in ammunition which does not have to penetrate a target (ex: mines and bombs).

COMPOSITION C

Alternate Nomenclature:

Plastic explosive (along
with other composition
C-series explosives)

Composition:

Cyclonite-----	88.0%
Oil-----	11.4%
Lecithin-----	0.6%

Characteristics:

Composition C is a white to brown, hand-tamped explosive. It will detonate when subjected to a temperature of 285°C for five seconds. Composition C is non-reactive with metals, but is unstable. It is less effective than composition B but 21% more efficient than TNT in shaped charges. It retains its plasticity between 0° and 40°C, but below 0°C it becomes brittle and insensitive while above 40°C it becomes gummy and tends to exude oil. Lecithin is used to prevent the formation of large crystals which would increase sensitivity.

Uses:

Composition C is used as a demolition agent by many countries. A similar composition, called "oshitsuyaku" (see entry), was used by Japan during World War II.

COMPOSITION C2

COMPOSITION C-2

Alternate Nomenclature:

Plastic Explosive (along
with other composition
C-series explosives)

Composition:

Cyclonite-----	78.7%
Mononitrotoluene-----	2.7%
Dinitrotoluene-----	12.0%
TNT-----	5.0%
Wet Nitrocellulose-----	0.6%
Dimethylformamide-----	1.0%

Characteristics:

Composition C-2 is a white to yellow-brown, hand-tamped explosive. It will detonate when subjected to a temperature of 285°C for five seconds. Composition C-2 is plastic from -30° to 52°. It becomes less plastic in hot storage because of evaporation of volatile matter. Composition C-2 is more sensitive and effective than composition C since less than 1% of the material is inert compared with 12% in composition C.

Uses:

Composition C-2 is used as a plastic demolition agent.

COMPOSITION C-3

Alternate Nomenclature:

Plastic Explosive (along
with other composition
C-series explosives)

Composition:

Cyclonite-----	77.1%
Tetryl-----	3.0% }
Mononitrotoluene-----	5.0% }
Dinitrotoluene-----	10.0% } Plasticiser or plasticizer
TNT-----	4.0% }
Wet Nitrocellulose-----	0.9% }

COMPOSITION C-3

Characteristics:

Composition C-3 is a yellowish, puttylike, hand-tamped explosive. It will detonate when subjected to a temperature of 280°C for five seconds. Two classes of composition C-3 (Class A and Class B) are manufactured, in accordance with military specifications. The two classes differ only with respect to acidity (see Uses below). Composition C-3 is pliable at normal temperatures and can be easily molded to suit requirements. It is hygroscopic, but its brisance is unchanged after total immersion in water. It is more brisant than TNT, but less brisant than tetryl. Its sensitivity to impact is similar to that of TNT, but much less than that of cyclonite. Composition C-3 is somewhat unstable. When exposed to air at 25°C for five days, it loses 1.2% of its weight because of its volatility. Moreover, it becomes hard and brittle at -29°C and undergoes considerable exudation at 77°C.

Manufacture:

Tetryl, nitrocellulose, and the nitrotoluenes are mixed together to form the plasticizing agent. This plasticizer is then heated to 100°C and wet cyclonite is added. The mixture is stirred and heated until the composition is uniform and all the water has been driven off.

Uses:

Class A composition C-3 is used for the manufacture of demolition blocks; class B composition C-3 is used both for the manufacture of demolition blocks and the loading of ammunition where a lower acidity is desired.

Comments:

Composition C-3 was developed to improve the instability of composition C-2. It has not been completely satisfactory in this respect, and is being replaced by composition C-4 (see entry).

COMPOSITION C-4

Alternate Nomenclature:

Harrisite

Plastic Explosive (along
with other composition
C-series explosives)

COMPOSITION C4

Composition:

Cyclonite-----	91.0%
Polyisobutylene-----	2.1%
Motor Oil-----	1.6%
Di-(2-ethylhexyl) sebacate-----	5.3%

Characteristics:

Composition C-4 is a dirty white to light brown, puttylike, hand-tamped explosive. It will explode when subjected to a temperature of 290°C for five seconds. Composition C-4 has a higher stability than composition C-3. It is essentially nonhygroscopic. It will not harden at -57°C and will not undergo exudation at 77°C. Composition C-4 is less sensitive to impact and slightly more brisant than composition C-3. The two compositions are about equal in sensitivity to initiation.

Manufacture:

The isobutylene plasticizer, previously made up in ether, is mixed with cyclonite (crystals of 44 micron size or less) either by machine or by hand kneading and rolling (machine mixing uses a Schrader Bowl mixer). The mixture is then dried at 60°C.

Uses:

Composition C-4 is used primarily for demolition blocks. It is well suited for underwater demolition if properly packaged. It is ideally suited for cutting through steel because of its plasticity and its high velocity of detonation.

Comments:

Composition C-4 has been developed to improve the instability and hygroscopicity of composition C-3 (see entry). It has not, however, entirely replaced composition C-3.

COMPOSITION T-9

See COMPOSITE PROPELLANT

CORDITE

CORDITE

See also DOUBLE-BASE SMOKELESS PROPELLANT

Alternate Nomenclature:

None

Foreign Nomenclature:

British:	Cordite
French:	Cordite
German:	Kordit (rarely, cordite)
Hungarian:	Kordit
Italian:	Cordite
Russian:	Kordit
Spanish:	Cordita

Composition:

A typical composition is listed below. Percentages may vary depending upon the manufacturer and the end-use of the product.

Guncotton-----	37%
Nitroglycerin-----	58%
Mineral Jelly-----	5%

Characteristics:

Cordite is very similar to brown twine in appearance (hence its name). Its other characteristics are those listed for double-base smokeless propellants (see entry).

Manufacture:

Nitrocellulose (guncotton type) and nitroglycerin are mixed together by means of acetone. The mineral jelly is then added, and upon removal of the acetone the colloid is pressed into cords.

Uses:

Cordite is used in Great Britain as the propellant for the armed forces. In this respect, the term is often used loosely to apply to propellants deviating considerably from the composition listed above. Cordite is used throughout Western Europe as a standard military propellant. In the United States, it does not meet satisfactorily all U.S. Army specifications.

Comments:

Because of the gun-barrel erosion caused by cordite, a modification was introduced, called "cordite M.D." (i.e., "cordite, modified") and containing 65% nitrocellulose (guncotton type), 30% nitroglycerin, and 5% mineral jelly. A further modification, called "cordite R.D.B." (Research Department B), was introduced during World War I to extend the supply of solvents. For this purpose, cordite R.D.B. contains nitrocellulose of low nitration. The formula called

for 52% nitrocellulose, 42% nitroglycerin, 6% mineral jelly. Cordite M.D. is the preferred type.

CRESSYLITE

Alternate Nomenclature:
None

Composition:

Picric Acid----- 60%
Trinitroresol----- 40%

Characteristics:

Cressylite is a high explosive closely related to picric acid. It is somewhat less sensitive to impact and shock than picric acid, and consequently requires a more powerful charge to initiate its detonation.

Uses:

Cressylite is now rarely used as an explosive. It was first used by France as a bursting charge and subsequently was used by most countries. It was quickly replaced by TNT, however, when an inexpensive manufacturing process for TNT was found. France and the Soviet Union still use cressylite to a limited extent.

CYCLONITE

Alternate Nomenclature:
Cyclotrimethylene-
trinitramine
Trimethylenetrinitramine

NOTE: The term "RDX," although British in origin, is often used interchangeably with "cyclonite" in the U.S.

Foreign Nomenclature:
British: RDX (Research Department Explosive)
French: Exogène
German: Hexogen
Japanese: Shouyaku, Tun-o-yaku
Italian: T-4, Trimetilenetri-nitroamina
Russian: Cheksogén, Ch
Spanish: Ciclonita, Fenógeno

CYCLONITE

Composition:

$(\text{CH}_2)_3\text{N}_3(\text{NO}_2)_3$, or $\text{C}_3\text{H}_6\text{N}_6\text{O}_6$ -- chemical compound containing the following percentages by weight of the elements:

Carbon----- 16.22%
Hydrogen---- 2.72%
Nitrogen---- 37.81%
Oxygen----- 43.22%

Characteristics:

Cyclonite is a colorless or white, press-loaded high explosive melting at 204°C . It will detonate when subjected to a temperature of 260°C for five seconds. Cyclonite is classified into two types, in accordance with military specifications. Type A must have a minimum melting point of 200°C (the melting point given above is for pure cyclonite) and a maximum acidity of 0.05% (as nitric acid); type B must have a minimum melting point of 190°C and a maximum acidity of 0.02% (as acetic acid). There is also a slight difference in granulation between the two grades. Type B is the less pure of the two types, the impurity consisting mainly of HMX (see entry). Cyclonite has no reaction with aluminum or stainless steel. It reacts slightly with copper, brass, mild steel, and cadmium, and when damp it also reacts slightly with nickel and zinc. Cyclonite is nonhygroscopic at 30°C and 90% relative humidity. It is as stable as TNT at temperatures under 100° to 150°C . It has been stored for ten months at 85°C without any change in stability. Cyclonite has the same sensitivity to impact as tetryl, but is more sensitive to friction than tetryl. Both types of cyclonite are equally sensitive to impact, friction, heat, and initiation. Cyclonite is more powerful than tetryl and is considered the second most powerful standard military explosive (nitroglycerin being the first).

Manufacture:

Formaldehyde is reacted with ammonia to yield hexamethylene tetramine, which in turn is nitrated to yield crude cyclonite. The cyclonite is collected by filtration and is washed and ground.

Uses:

Cyclonite is used mainly in mixtures (composition A, compositions B and B-2, compositions C, C-2, C-3, and C-4, torpex, PTX-1, and PTX-2), but can be used alone as a subbooster, booster, and bursting charge.

Comments:

The chief impurity occurring in the manufacture of cyclonite is HMX (see entry). Its presence in cyclonite is not considered harmful.

CYCLOTETRAMETHYLENE-TETRAMINE

CYCLOTETRAMETHYLENETETRA-NITRAMINE

See HMX

CYCLOTRIMETHYLENENITRAMINE

See CYCLOLITE

OXOLOTOL

See COMPOSITION B

DBX

Alternate Nomenclature:
Depth Bomb Explosive

Composition:

Ammonium Nitrate-----	21%
Cyclonite-----	21%
TNT-----	40%
Aluminum-----	18%

Characteristics:

DBX is a gray, cast-loaded explosive. It will ignite when subjected to a temperature of 400°C for five seconds. DBX, intended as an improvement over torpex, is less sensitive and more powerful than torpex, and is very suitable for depth bombs. It is, however, hygroscopic and reacts with metals in the same manner as amatol (see entry).

Manufacture:

Wet cyclonite is slowly added to molten TNT. The mixture is stirred until all water is removed. Ammonium nitrate is added, the mixture is heated and stirred, and aluminum is added. Stirring is continued while the mixture is cooled.

DBX can also be made by adding 21% ammonium nitrate and 18% aluminum to 42% composition B (of 50/50 proportions) plus 19% molten TNT.

Uses:

DBX may be used as a bursting charge in dept' bombs.

Comments:

DBX may be considered as torpex in which half of the cyclonite content has been replaced by ammonium nitrate. Although DBX has been used in the United States and Great Britain, it has not been standardized for general use.

DDNP

Alternate Nomenclature:

Diazodinitrophenol
Diazol
Dinol

Composition:

$C_6H_2(N_2)(O)NO_2)_2$ or $C_6H_2N_4O_5$ -- chemical compound containing the following percentages by weight of the elements:
 Carbon----- 34.30%
 Hydrogen---- 0.96%
 Nitrogen---- 26.67%
 Oxygen----- 38.07%

Characteristics:

DDNP is a greenish yellow to brown, press-leaded explosive melting at 157°C. It will explode when subjected to a temperature of 195°C for five seconds. DDNP is nonhygroscopic. It is as sensitive to impact and friction as lead azide. It is as brisant as TNT, and more brisant than mercuric fulminate. Its stability is satisfactory in that it can be stored at 50°C for at least 30 months without change.

Manufacture:

Picramic acid is prepared by purifying the product resulting from the evaporation of a mixture of an alcoholic solution of ammonium picrate (explosive D) and ammonium sulfide. Picramic acid is suspended in hydrochloric acid, and the mixture is cooled and stirred. Sodium nitrite, diluted with water, is added and the resulting precipitate is filtered and washed. This precipitate is dissolved in hot acetone; upon the addition of ice water, DDNP is precipitated.

Uses:

DDNP is used extensively in commercial blasting caps, and to a lesser extent in military priming compositions and detonators.

DEGN

DEGN

See also PROPELLANTS, FOREIGN
(German and Italian Propellants)

Alternate Nomenclature:

Diethyleneglycol Dinitrate
Dinitrodiglycol

Composition:

$O(CH_2CH_2NO_2)_2$ or $C_4H_8N_2O_7$ -- chemical compound containing the following percentages by weight of the elements:
Carbon----- 24.50%
Hydrogen---- 4.11%
Nitrogen---- 14.28%
Oxygen----- 57.11%

Characteristics:

DEGN is a colorless explosive compound. It will detonate when subjected to a temperature of 237°C for five seconds. Its sensitivity to impact and its power are less than those of nitroglycerin; it is, however, more powerful than TNT. DEGN is extremely stable, much more so than nitroglycerin. When free of acid, it can withstand storage for long periods of time at ordinary temperatures without change. DEGN has a high volatility and it will impart this characteristic to explosive compositions of which it is an ingredient. However, it has the advantage of cooling the temperature of explosion of explosive compositions, and thereby reducing gun barrel erosion.

Manufacture:

Distethylene glycol is reacted with mixed acid to precipitate DEGN. The separated DEGN is purified by washing (the purity of the product depending upon the purity of the ingredients).

Uses:

DEGN was used more or less extensively by Germany and Italy during World War II in propellant compositions of the double- and triple-base types, as a replacement for nitroglycerin. The Soviet Union has also employed DEGN in certain propellant compositions, but not to any large extent.

DEPTH BOMB EXPLOSIVE

See DBX

DETONATING OIL

DETONATING OIL

See NITROGLYCERIN

DIAZODINITROPHENOL

See DNP

DIAZOL

See DDNP

DIETHYLENEMEGLYCOL DINITRATE

See DEGN

DINITRODIGLYCOL

See DEGN

DINITROETHYLENEDIAMINE

See EDNA

DINOL

See DDNP

DONARITE

DONARITE

Alternate Nomenclature:
None

Foreign Nomenclature:
German: Donarit

Composition:

The following compositions may be taken as representative:

	Donarite 1 Gelatin type	Donarite 1 Powdery type	Donarite 2 Powdery type
Nitroglycerin-----	...	...	4.0%
Nitroglycol-----	22.0%	...	...
Colloid Cotton-----	1.0%	...	...
Ammonium Nitrate-----	55.0%	81.5%	84.0%
Sodium Nitrate-----	10.0%	...	...
Aromatic Nitrocompounds-----	...	...	3.0%
TNT-----	5.0%	14.0%	...
DNT (liquid)-----	6.0%	2.0%	...
Wood Meal-----	0.8%	2.0%	9.0%
Dye-----	0.2%	0.5%	...

Comments:

Donarites are a group of German dynamite-type mining explosives. Donarite 1, listed above, was manufactured during World War II. Another type of donarite, containing 67-80% ammonium nitrate, 12-25% TNT, 3-8% nitroglycerin, 0.2% nitrocellulose, and 4% vegetable meal, was manufactured for military purposes and was used as a grenade filler. Donarites currently being used are of uncertain composition.

DOUBLE-BASE COLLOIDED
PROPELLANT

See DOUBLE-BASE SMOKELESS PROPELLANT

DOUBLE-BASE SMOKELESS
PROPELLANT

DOUBLE-BASE SMOKELESS
PROPELLANT

See also BALLISTITE, CORDITE,
NITROCELLULOSE, NITROGLYCERIN,
SMOKELESS PROPELLANT

Alternate Nomenclature:

Solventless Propellant
or Powder
Double-Base Powder
Double-Base Colloidal
Propellant

Foreign Nomenclature:

Hungarian: Kettős alapanyagú lőpor
Russian: Nitroglitserinovyye
perokh
Spanish: Pólvora de doble base

Composition:

Double-base smokeless propellants usually contain nitrocellulose and nitroglycerin as the principal ingredients. They may consist of from 60 to 80% nitrocellulose and from 20 to 40% nitroglycerin. In some cases, however, nitroglycerin is partially replaced by other organic nitrates having the property of gelatinizing nitrocellulose. Stabilizers and other additives are usually included to achieve desired results.

Characteristics:

Double-base propellants vary from olive to black in color and are manufactured in as many forms as single-base propellants, i.e., strips, flakes, spheres, pellets, tubes, and perforated cylindrical shapes. Double-base propellants have greater potential than single-base propellants because of the additional energy content available from nitroglycerin. Double-base propellants are less hygroscopic than single-base types. Moreover, double-base propellants contain less solvent than single-base types and therefore have a higher inherent ballistic stability.

Manufacture:

Double-base propellants are manufactured by one of two processes, the "solvent" process and the "nonsolvent" or "solventless" process. The solvent process is similar to that used for the manufacture of single-base smokeless propellants (see entry), except that a mixture of ethanol and acetone is used as the solvent and the solvent recovery procedure is omitted because of the hazard involved in recovering solvents containing nitroglycerin. The nonsolvent process is used when the nitroglycerin and other colloidizing agents constitute approximately 40% of the composition. In this process, wet nitrocellulose is mixed with nitroglycerin. The stabilizer (centralite) is mixed in and water removed by centrifuge. The colloid is partially dried, and any remaining ingredients are mixed in. The remaining water is removed by rolling.

DOUBLE-BASE SMOKELESS
PROPELLANT

Uses:

Before World War II, double-base propellants were limited to use in mortar and small arms ammunition. Since then, they have been used in most types of ammunition, as well as in rocket propellant compositions.

Comments:

Double-base propellants have replaced single-base propellants in many ammunition propellant applications. They have the advantage of higher energy content and greater ease of stabilization. Since double-base propellants have a greater potential, a specified quantity of double-base propellant will give better ballistic results than an equal quantity of single-base propellant.

The term "double-base colloidized propellant" for double-base smokeless propellant is coming into increasingly wide usage since it is more accurate in its description (these propellants are not entirely smokeless).

DUNNITE

See EXPLOSIVE D

DUOBEL

See PERMISSIBLE EXPLOSIVE

DYNAMITE

See also ASTRALITE, DONARITE, DYNAMON, NITROGLYCERIN, and specific types listed under Composition below.

Alternate Nomenclature:
See Comments below

Foreign Nomenclature:

French:	Dynamite
German:	Dynamit, Sprengstoff
Hungarian:	Dinamit
Italian:	Dinamite
Japanese:	Kaiyaku
Russian:	Dinamit
Spanish:	Dinamita

German dynamites: GELATINE-DINAMIT,

DYNAMITE

gelatin dynamite;
GUARDYNAMIT, guhr
dynamite; SICHER-
HEITS DYNAMIT,
safety dynamite;
SPRENGGELATINE,
blasting gelatin.

Japanese dynamites (trade
names of the Nippon Oils
and Fats Co., Ltd.):
MATSU, blasting gelatin;
SAKURA NO. 1 & NO. 2,
gelatin; KIRI NOS. 1,
2, 3, SHIN-KIRI, ammonia
gelatin; TAKE NOS. 1,
2, & 3, KEYAKI, special
ammonia gelatin; SHIN-
KYORYOKU, ammonia explosive;
SHIRAME, TOKU-SHIRAME
NOS. 1 & 2, permissible
gelatin; SHOAN, SHIN-
TOKU-SHOAN, permissible
ammonia dynamite;
L-SHOAN, low density
permissible dynamite;
KO-SHOAN BAKUYAKU, SHOAN
BAKUYAKU NOS. 10, & 20,
permissible ammonium
nitrate explosive.

Soviet dynamites: GREMUCHII
STUDEN', blasting gelatin;
GRISUTIN, gelatinized
nitroglycerin; PLASTICHESKII
DINAMIT, plastic dynamite.

Composition:

All dynamites except military dynamite contain nitroglycerin plus varying combinations of absorbent materials, oxidizers, antacids, and freezing-point depressants. Dynamites can be grouped into the basic types listed below:

Blasting Gelatin
Gelatin Dynamite
Low-Freezing and Non-Freezing Dynamites
Military Dynamite
Permissible Explosive
Straight Dynamite

For the composition of each type, see individual entries.

Characteristics:

For specific characteristics, see entries for the types listed under Composition above. In general, dynamites are sensitive to shock, friction, and heat, unless desensitized by inert materials which, in turn, reduce explosive power. However, dynamites are not as sensitive to moderate shocks as nitroglycerin, and are safer to handle and transport.

Manufacture:

For specific processes, see entries for the types listed under Composition above. The manufacturing processes normally involve simply a mechanical mixing of the nitroglycerin with the other ingredients.

Uses:

Dynamites are used universally for blasting operations both above- and below-ground, and underwater. The specific types listed under Composition above are used to accomplish specified blasting operations. For example, the blasting of soft rock or earth is achieved with a straight ammonia dynamite because of the explosive's great heaving force and relatively low rate of detonation; the blasting of hard tough rock is achieved through a gelatin dynamite, which has a low heaving force but a high rate of detonation.

Comments:

The term "dynamite" has both a general and a specific meaning. As a general term it is used to refer to all the mixtures listed under Composition above. As a specific term, it is used as an alternate reference to straight dynamites.

Military blasting operations usually utilize the same types of dynamites as commercial operations. However, military dynamite has been designed for certain blasting and demolition work (see entry).

Recently, a trend has developed in the United States leading away from nitroglycerin explosives to cheaper blasting explosives such as those based on ammonium nitrate.

DYNAMITE NO. 1

See STRAIGHT DYNAMITE

DYNAMITE WITH ACTIVE BASE

DYNAMITE WITH ACTIVE BASE

See STRAIGHT DYNAMITE

DYNAMITE WITH INACTIVE BASE

See STRAIGHT DYNAMITE

DYNAMON

Alternate Nomenclature:
None

Composition:

Dynamon, as originally made in Austria, had the following compositions:

	Dynamon	Wetter Dynamon
Ammonium Nitrate-----	87 to 88%	94%
Red Charcoal-----	12 to 13%	4%
Potassium Nitrate-----	...	2%

The present compositions, as used in the Soviet Bloc, are as follows:

Ammonium Nitrate-----	89%	90%
Peat-----	11%	...
Vegetable Meal-----	...	10%

Characteristics:

Dynamons are very stable in storage. They are more powerful than straight dynamites, to which they are closely related.

Uses:

Dynamons are used by the Soviet Bloc for hard ore blasting and for excavating. They are no longer used in western Europe.

E. C. POWDER

E. C. POWDER

Alternate Nomenclature: Bulk Powder

Composition:

Nitrocellulose (13.2% N)-----	80%
Barium Nitrate-----	8%
Potassium Nitrate-----	8%
Starch-----	3%
Aurine Dye-----	0.25%
Diphenyleamine-----	0.75%

Characteristics:

E. C. powder is an orange or pink, coarse sand textured explosive. It will detonate when subjected to a temperature of 200°C for five seconds. When dry it reacts slightly with copper, magnesium, magnesium-aluminum alloy, and mild steel plated with copper or zinc. When wet it severely attacks copper, brass, magnesium, magnesium-aluminum alloy, mild steel, mild steel coated with acid-proof black paint, and mild steel plated with copper, cadmium, nickel, or zinc. E. C. powder absorbs moisture readily and therefore must be protected from the atmosphere. It is sensitive to friction, shock, and heat. It burns extremely rapidly in the open, but detonates if confined. It is, therefore, sufficiently sensitive to be used as a high explosive as well as a propellant. It is usually exploded by flame from a primer or fuze.

Uses:

E. C. powder was used at one time as a bursting charge in fragmentation hand grenades. It is now used in shotgun shells and blank ammunition. Its burning rate prevents its use as a standard military propellant.

Comments:

The name "E. C. powder" is an abbreviation for Explosives Company Powder since it was invented by the Explosives Company at Stowmarket in England. It was one of the first nitrocellulose compositions to be developed.

ECIRASITE

ECRASITE

Alternate Nomenclature:
Ammonium Cressylate

Foreign Nomenclature:
French: Ecrasite
German: Ekrasit
Hungarian: Ekrasit
Italian: Ecrasite
Russian: Ekrazit
Spanish: Ecrasita

Composition:

$C_6H_5CH_2(NO_2)_2ONH_4$ or $C_7H_8N_4O_7$ -- chemical compound containing the following percentages by weight of the elements:
Carbon----- 32.31%
Hydrogen---- 3.10%
Nitrogen---- 21.54%
Oxygen----- 43.05%

Characteristics:

Ecrasite is a high explosive closely related to picric acid. It is highly stable and only slightly sensitive to impact. It is twice as powerful as dynamite, but its detonation is difficult to initiate.

Uses:

Ecrasite is now rarely used as an explosive. It was formerly used as a bursting charge, especially by Austria. It is still used by the Soviet Bloc to a very limited extent.

* * * *

EDNA

Alternate Nomenclature:
Ethylenedinitramine
Dinitroethylenediamine
Haleite

Composition:

$(CH_2)_2(NH)_2(NO_2)_2$ or $C_2H_6N_4O_4$ -- chemical compound containing the following percentages by weight of the elements:
Carbon----- 16.00%
Hydrogen---- 1.03%
Nitrogen---- 37.33%
Oxygen----- 42.64%

Characteristics:

EDNA is a white to buff, press-loaded explosive melting with decomposition at 177.3°C. It will detonate when subjected to a temperature of 189°C for five seconds. Dry EDNA will not react with most metals; in the presence of moisture, however, it will react with brass, cadmium, copper, nickel, mild steel, and zinc. It is virtually nonhygroscopic, absorbing only 0.01% moisture when in an atmosphere of 90% relative humidity at 30°C. EDNA is less sensitive to impact than tetryl but more sensitive than TNT; it is somewhat less sensitive to initiation than tetryl. It is more brisant than tetryl. Although EDNA is less stable than tetryl, it has been stored for five months at 65°C and for 30 months at 50°C without any trace of instability.

Manufacture:

Ethyleneurea is reacted with either concentrated nitric acid or mixed acid to yield dinitroethyleneurea. The dinitroethyleneurea is filtered out of the mother liquor, washed, and mixed with seven times its weight of water. This is boiled until the evolution of carbon dioxide gas stops. The resulting EDNA, gathered by filtration, is washed and dried.

Uses:

EDNA has been used as both a bursting charge and an ingredient of ednatol (see entry).

Comments:

The sensitivity of EDNA precludes its use as a standard military bursting charge. It is useful chiefly as an ingredient for ednatol (see entry).

EDNATOL

Alternate Nomenclature:
NoneComposition:

EDNA----- 60% 55%
TNT----- 40% or 45%

EDNATOL

Characteristics:

Ednatol is a dirty white to buff, cast-loaded explosive which melts at 80°C (55/45 type). Ednatol 55/45 will detonate when subjected to a temperature of 190°C for five seconds. When dry, it is slightly corrosive to copper, mild steel, and zinc. When damp, it is much more corrosive to these metals, and also corrodes cadmium and nickel. Ednatol is practically nonhygroscopic. Its sensitivity to impact and initiation is greater than that of TNT and less than that of EDNA. It will not detonate when hit by a rifle bullet, although it will occasionally ignite. Ednatol 60/40 is 1½ more powerful than TNT; ednatol 55/45 is 20% more powerful than TNT. Ednatol's stability is equal to that of EDNA at temperatures up to 100°C. However, it becomes unstable at higher temperatures, and at 120°C it is considerably less stable than EDNA.

Manufacture:

TNT is heated to about 100°C and melted. Wet EDNA is slowly added and the mixture is stirred and heated until all moisture has been removed. The mixture is then cooled to about 85°C to make it suitable for pouring.

Uses:

Ednatol can be used as a bursting charge in shell and bombs. Although it has been standardized in the United States, it has not yet been used to any great extent.

ENNAYAKU

Alternate Nomenclature:

None

Foreign Nomenclature:

The entry is given in the Japanese nomenclature; there is no English equivalent.

Composition:

Potassium Chlorate-----	80%
Mononitrotoluene-----	15%
Castor Bean Oil-----	5%

Comments:

Ennayaku is Japanese explosive composition which was used during World War II as a bursting charge, probably for grenades and mortar shells.

ENTOYAKU

ENTOYAKU

Alternate Nomenclature:

None

Foreign Nomenclature:

The entry is given in the Japanese nomenclature; there is no English equivalent.

Composition:

Potassium Chlorate----- 80%
Dinitrotoluene----- 16%
Castor Oil Bean----- 4%

Comments:

Entoyaku is a Japanese explosive composition which was used during World War II as a bursting charge for grenades and mortar shells, and in demolition charges.

ETHYL PICRATE

See TNPH

ETHYLENEDIAMINE DINITRATE

See EDD

EXPLOSIVE D

See also AROMATIC NITRO COMPOUNDS

Alternate Nomenclature:

Ammonium Picrate
Ammonium Trinitrophenolate
Dunnite
See Comments below

Foreign Nomenclature:

French: Picrate d'ammoniaque
German: Ammoniumpikrat
Hungarian: Dunnit robbanóanyag
Italian: Picrato ammonico
Russian: Pikrit ammonia,
 Pikrinovo-ammoniyi ammonii
Spanish: Picrato amónico

Composition:

$C_6H_4O_4(NO_2)_3$ or $C_6H_6N_4O_7$ -- chemical compound containing the following percentages by weight of the elements:

Carbon ----- 29.28%
Hydrogen---- 2.46%
Nitrogen---- 22.76%
Oxygen ----- 45.50%

EXPLOSIVE D

Characteristics:

Explosive D is a yellow to orange, press-loaded explosive. It will detonate when subjected to a temperature of 318°C for five seconds; it will not melt. It does not react with metals when dry; when wet, however, explosive D will react to form sensitive metallic picrates. The presence of small traces of these picrates in the explosive may lower the detonation temperature. Explosive D is somewhat hygroscopic, absorbing over 5% by weight of water during storage in a moisture-saturated atmosphere. It is insensitive to friction and shock; the presence of moisture reduces sensitivity to initiation. Explosive D is less sensitive than TNT.

Manufacture:

The manufacturing process is extremely simple. Explosive D crystallizes out of a cooling solution of picric acid and hot water neutralized with aqueous ammonia. The precipitate is dried at 45°C, and then is screened and packed.

Uses:

Explosive D is used as the bursting charge in armor-piercing shells. It is also coming into widespread use as the organic fuel in composite propellants (see entry). It has also been used to some extent in France, mixed with potassium nitrate, as a propellant.

Comments:

The insensitivity of explosive D to shock and friction makes it an excellent bursting charge for armor-piercing projectiles since it will not detonate upon impact. In other respects, however, it is inferior as a high explosive to TNT.

The term "explosive D" originally was given to ammonium picrate in order to keep the explosive composition secret, the "D" standing for Dunn, the name of its proponent. The explosive was called unofficially Dunnite. At present, the term "explosive D" is in general usage, and "Dunnite" is only rarely used.

EXPLOSIVE OIL

See NITROGLYCERIN

EXTRA DYNAMITE

See STRAIGHT DYNAMITE

FLASHLESS AND SMOKELESS COMPOSITIONS

FLASHLESS AND SMOKELESS COMPOSITIONS

See also SINGLE-BASE SMOKELESS PROPELLANT

Alternate Nomenclature:

FNH (flashless, nonhygroscopic)
and NH (nonhygroscopic)

Comments:

For Characteristics and Manufacture see SINGLE-BASE SMOKELESS PROPELLANT. Flashless and smokeless compositions are a class of single-base propellants used chiefly in artillery ammunition. Standard U.S. compositions include M-1, M-3, M-4, M-6, M-10, M-12, and M-14 types. Ingredients vary, but all contain nitrocellulose plus nitrotoluene and other materials. They are not truly nonhygroscopic, but are much less hygroscopic than pyrocellulose propellants.

FNH (flashless, nonhygroscopic) See FLASHLESS AND SMOKELESS COMPOSITIONS

FRENCH MIXTURE

Alternate Nomenclature:

The entry is given in the English equivalent of the Russian nomenclature; there is no corresponding U.S. explosive.

Foreign Nomenclature:

Russian: Frantsuzskaya smes'

Composition:

Picric Acid----- 80%
Dinitronaphthalene---- 20%

Comments:

French mixture is a Soviet composition which has been used to fill artillery ammunition, bombs, antitank mines, and for demolition charges.

FULMINATE OF MERCURY

See MERCURIC FULMINATE

GEL-COALITE

GEL-COALITE

See PERMISSIBLE EXPLOSIVE

GELATIN DYNAMITE

See also DYNAMITE

Alternate Nomenclature:

Nitrogelatin
Nitrogelin

Foreign Nomenclature:

British: Gelignite
French: Gélatine-dynamite,
nitrogélatine
German: Gelatinedynamit,
nitrogelatino
Hungarian: Nitrozelatinos dinamit,
dinamitgél, gelignit
Italian: Gelatina-dinamite,
nitrogelatina
Japanese: SAKURA NOS. 1 & 2 (trade
name of Nippon Oils and
Fats Co., Ltd.)
Russian: Grisutin, studenisty
dinamit
Spanish: Gelatina dinamita,
nitrogelatina

Composition:

Gelatin dynamites consist of blasting gelatin (see entry) to which wood meal and sodium or potassium nitrates (saltpeters) have been added. They also may contain ammonium nitrate (in which case they are called "ammonia gelatin dynamites") and aromatic nitro compounds. Gelatin dynamites normally have a lower nitrocellulose content than blasting gelatins and thus are often spoken of as being "thinner" or softer gelatins. The following compositions have been used in the United States:

	Strength						
	30%	35%	40%	50%	55%	60%	70%
Nitroglycerin-----	23.0%	28.0%	33.0%	41.2%	46.0%	50.0%	60.0%
Nitrocellulose-----	0.7%	0.9%	1.0%	1.5%	1.7%	1.9%	2.4%
Sodium Nitrate-----	62.3%	58.1%	52.0%	45.5%	42.3%	38.1%	29.6%
Combustible Material-	13.0%	12.0%	13.0%	10.0%	9.0%	9.0%	7.0%
Calcium Carbonate----	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%

Characteristics:

Gelatin dynamites are plastic and cohesive; they may be shaped and molded as desired. They may or may not be hygroscopic depending upon the types and quantities of ingredients. Exposure to moisture-laden atmosphere has caused difficulties because of the hygroscopicity of sodium nitrate and ammonium nitrate. Gelatin dynamites intended for tropical climates, therefore, usually contain potassium nitrate, which is more expensive than sodium nitrate but nonhygroscopic. Ammonium nitrate content, however, is desirable in some gelatin dynamites because of the particularly high strength it imparts to explosive mixtures. These ammonia gelatin dynamites are extremely hygroscopic and require special waterproof packing. Gelatin dynamites are about as sensitive to shock as blasting gelatin and gun dynamites. This sensitivity, however, varies depending upon ingredients. For example, potassium perchlorate will raise shock sensitivity while aromatic nitro compounds (see below) will depress this sensitivity. Moist gelatin dynamites are less sensitive to shock than the dry material. Sensitivity to initiation varies with nitrocellulose content. Gelatin dynamites with a relatively high nitrocellulose content require a strong blasting cap for detonation while those with a low nitrocellulose content can be detonated with a weak blasting cap. Long periods of storage may decrease sensitivity to initiation.

Under wartime conditions when glycerin has been in short supply, the nitroglycerin content in gelatin dynamites has been reduced to a low of 18%. Since such a composition contains relatively little "nitroglycerin-gelatin," it must be extended by the addition of aromatic nitro compounds such as TNT and dinitrotoluene, which partially dissolve in warm nitroglycerin but only desensitize it very little. When the compound cools, the nitro compound tends to crystallize out of solution and add its own characteristics to those of straight nitroglycerin.

Manufacture:

The "dope" which is made up of both the oxidizing agents (nitrates or perchlorates) and combustible materials (wood meal, cereal meal, charcoal, etc.), must be in as finely pulverized a state as possible. Accordingly, each ingredient must be ground to a fine consistency. The mixing and gelatinization processes are identical to those described for blasting gelatin (see entry), and are conducted with the same equipment.

Uses:

Gelatin dynamites are used for rock blasting and underwater blasting operations. The ammonia gelatin dynamites, despite their strength, are not suitable for hard ore or rock blasting because of their lower velocity of detonation and lower density.

GELOBEL

GELOBEL

See PERMISSIBLE EXPLOSIVE

GLUCOSE PENTANITRATE

See SUGAR NITRATE

GLYCERYL TRINITRATE

See NITROGLYCERIN

GREMUCHE-RTUTNAYA

Alternate Nomenclature:
None

Foreign Nomenclature:

The entry is given in the Russian nomenclature; there is no English equivalent. The literal translation of the term is "of mercuric fulminate."

Comments:

Gremuche-rtutnaya is a Soviet detonating cap composition consisting solely of mercuric fulminate, usually in 0.2-gram charges.

GRENITE

See also NITROSTARCH

Alternate Nomenclature:
None

Foreign Nomenclature:
None

Composition:

Grenite is a nitrostarch explosive whose composition varies according to the manufacturer and the product's end use. The composition listed below gives the input limits for each ingredient:

	Not less than	Not more than
Nitrostarch-----	95.50%	98.25%
Petroleum Oil -----	0.75%	2.00%
Gum Arabic-----	0.75%	2.00%
Moisture-----	...	1.00%

GRENITE

Characteristics:

Grenite appears as small white, hard granules. It is not significantly hygroscopic. It is less sensitive than straight nitrostarch. Petroleum ingredients reduce somewhat the sensitivity of straight nitrostarch.

Manufacture:

Grenite is prepared by spraying dry nitrostarch with a solution of the binding materials while agitating the mixture. The product is dried and screened to proper size.

Uses:

Grenite has been used only in grenades since it is too sensitive to setback for use in projectiles.

Comments:

As in the case of Trojan explosives (see entry), nitrostarch is now rarely used for military purposes except for training requirements.

QUANYL NITRAMINE

See NITROQUANIDINE

GUHR DYNAMITE

See STRAIGHT DINAMITE

GUNCOTTON

GUNCOTTON

See also NITROCELLULOSE, SINGLE-BASE
SMOKELESS PROPELLANT

Alternate Nomenclature:

None

Foreign Nomenclature:

French:	Coton-collodion, coton-nitré, coton- poudre, fulmicoton
German:	Kolloidumwolle, nitrozellulosepulver, schießbaumwolle, schießwolle
Hungarian:	Lögyapot
Italian:	Fulmicotone, cotone fulminante
Russian:	Piroksilin, khlop- chatobumaz'nyy, porokh
Spanish:	Algodón pólvora

Composition:

Uncolloided Nitrocellulose----	87%
Moisture-----	13%

Characteristics:

Guncotton is a white explosive material. It will ignite when subjected to a temperature of from 195° to 200°C for five seconds. It is nonreactive with metals. It is about 98% as strong as TNT. When dry it is 1% stronger than TNT. Like other single-base propellants, it is hygroscopic and unstable. 30% moisture will prevent ignition. It is about as sensitive as TNT. Dry, it is about as sensitive as PETN. See NITROCELLULOSE and SINGLE-BASE SMOKELESS PROPELLANT for other characteristics.

Manufacture:

See NITROCELLULOSE and SINGLE-BASE SMOKELESS PROPELLANT.

Uses:

Guncotton is commonly used as a propellant, rarely as a demolition agent.

Comments:

The term "guncotton" is commonly applied to forms of nitrocellulose containing 13% or more nitrogen.

HAISHOKUYAKU

HAISHOKUYAKU

Alternate Nomenclature:

None

Foreign Nomenclature:

The entry is given in the Japanese nomenclature; there is no English equivalent.

Composition:

Ammonium Perchlorate-----	77.0%
Cyclonite-----	17.0%
Silicon Carbide-----	1.5%
Paraffin-----	4.5%

Comments:

Haishokuyaku is a Japanese explosive composition which was used during World War II in demolition blocks.

HALEITE

See EINA

HARRISITE

See COMPOSITION C-4

HBX-1

See TORPEX

HERCOGEL A and HERCOGEL 2

See PERMISSIBLE EXPLOSIVE

HEXAMINE

See HEXITE

HEXANITE

HEXANITE

Alternate Nomenclature:
None

Foreign Nomenclature:
German: Hexa, Novit

Composition:

Hexite-----	40%
TNT-----	60%

Characteristics:

Hexanite is only slightly superior to TNT with respect to brisance and power, and is comparable to TNT with respect to sensitivity and stability. It does not react with metals.

Uses:

Hexanite was used by Germany during World War II as a bursting charge in mines, torpedoes, and depth charges.

Comments:

Hexanite has been used chiefly as a substitute for TNT. It does not offer any significant advantages other than lessening the demand for TNT.

HEXANITE, ALUMINIZED

Alternate Nomenclature:
None

Foreign Nomenclature:
German: Schiesswolle 18,
TSMV 1-101

Composition:

TNT-----	60%
Hexite-----	24%
Aluminum, Powdered-----	16%

Comments:

Aluminized hexanite was used extensively by the Germans during World War II as the main bursting charge in torpedo warheads. Its blast effect is greater than that of tritonal.

HEXANITRODIPHENYLAMINE

See HEXITE

HEXIL

HEXIL

See HEXITE

HEKITE

See Appendix I for additional uses.

Alternate Nomenclature:

Hexanitrodiphenylamine
Hexil

Composition:

$(NO_2)_3C_6H_2NHC_6H_2(NO_2)_3$ or $C_{12}H_5N_7O_{12}$ -- chemical compound containing the following percentages by weight of the elements:
Carbon----- 32.81%
Hydrogen---- 1.15%
Nitrogen---- 22.33%
Oxygen----- 43.71%

Characteristics:

Hexite appears as yellow to brownish yellow crystals. It melts at from 240° to 245°C. It is similar to tetryl in sensitivity and brisance, and is very stable.

Manufacture:

Aniline is condensed through the addition of dinitrochlorbenzene. The resulting dinitrophenylamine is nitrated to form the hexanitro compound.

Uses:

Hexite was used extensively by Germany during World War II as a booster, and, rarely, as a bursting charge.

HMX (beta-type)

Alternate Nomenclature:

Cyclotetramethylenetrinitramine
Homocyclonite
Tetranitrotetrazole-octane

Composition:

$C_4H_5N_8O_8$ -- chemical compound containing the following percentages by weight of the elements: Carbon----- 16.2%
Hydrogen---- 2.7%
Nitrogen---- 37.9%
Oxygen----- 43.2%

HMX (beta Type)

Characteristics:

HMX is a white explosive material which melts at from 273° to 280°C (depending upon the method of measurement). It will explode when subjected to a temperature of 327°C for five seconds. HMX occurs as an impurity or by-product in the manufacture of cyclonite (see entry). It is very similar to cyclonite in sensitivity, brisance, and strength, but is somewhat less powerful than its parent explosive. HMX is nearly explosive at 30°C and 95% relative humidity.

Comments:

HMX has not been used alone as an explosive to any great extent. It may, however, see increasing usage in booster applications.

HOMOCYCLONITE

See HMX

INCENDIARY COMPOSITIONS

Alternate Nomenclature:

None

Composition:

Examples of typical incendiary compositions are given below:

50/50 Magnesium-Aluminum Alloy-----	48.0%	-----	48.0%
Barium Nitrate-----	50.5%	-----	50.5%
Linseed Oil-----	1.5%	-----	...
Asphaltum-----	...	-----	1.5%

Comments:

Incendiary compositions must be sensitive to the force of impact of the projectiles which carry them but must be insensitive to the force of setback. They are chemicals which ignite at the bursting of the projectile, and undergo burning rather than detonation. Such compositions are even less sensitive to impact than the least sensitive of the standard high explosives and have relatively high explosion temperatures (585°C).

INDEPENDENT (series)

See PERMISSIBLE EXPLOSIVE

INDEPENDENT GEL-A

See PERMISSIBLE EXPLOSIVE

JUDSON POWDER

See STRAIGHT DYNAMITE

K-1 MIXTURE

Alternate Nomenclature:

The entry is given in the English equivalent of the Russian nomenclature; there is no corresponding U.S. explosive.

Foreign Nomenclature:

Russian: K-1 splav

Composition:

TNT-----	70%
Dinitrobenzene----	30%

Characteristics:

K-1 mixture is less brisant than TNT, but it is still too brisant for effective fragmentation of cast iron containers; it will shatter the container into fragments too small to be of much use. To reduce this high brisance, long blocks of less brisant explosives such as schneiderite have been inserted into K-1 mixture with favorable results. K-1 mixture is a toxic explosive, and is therefore becoming obsolete.

Uses:

K-1 mixture has been used by the Soviet Union as a bursting charge in some cast iron land mines. It is being replaced by K-2 mixture (see entry).

K-2 MIXTURE

K-2 MIXTURE

Alternate Nomenclature: The entry is given in the English equivalent of the Russian nomenclature; there is no corresponding U.S. explosive.

Foreign Nomenclature:

Russian: K-2 splav

Composition:

TNT----- 80%
Trinitronaphthalene---- 20%

Comments:

K-2 mixture has been used by the Soviet Union as a bursting charge in cast iron land mines. It is replacing K-1 mixture (see entry) because of the lower toxicity of K-2 mixture.

KALIIALMATRIT NO. 55

See also ALMATEITE

Alternate Nomenclature:
None

Foreign Nomenclature:

The entry is given in the Russian nomenclature; there is no English equivalent.

Composition:

Potassium Chlorate---- 88%
Combustible----- 12% (containing 5% vaseline, 30% paraffin, 65% rosin)

Comments:

Kaliialmatrit no. 55 is a Russian commercial explosive of the almatrite class. It has a brisance lower than that of TNT.

KENDR

KUNBF

Alternate Nomenclature

Potassium Dinitrobenzofuran

Compositions

C₆H₄N₄O₂K -- chemical compound containing the following
percentages by weight of the elements: Carbon----- 27.3%
Hydrogen----- 0.4%
Nitrogen----- 21.2%
Oxygen----- 36.5%
Potassium----- 7.4.8%

Characteristics:

KDNBF is an orange to brown, press-loaded explosive with a melting point of 210°C. It will explode when subjected to a temperature of 250°C for five seconds. KDNBF is extremely sensitive to impact. It is only slightly hygroscopic and is stable in storage (less than 0.1% of the material is lost when it is subjected to 100°C temperatures for four days).

Manufacture:

Alkaline sodium hypochlorite is reacted with benzofuroxan. The latter is dissolved in concentrated sulfuric acid and nitrated with mixed acid. The resulting dinitrobenzofuroxan is neutralized with potassium bicarbonate. Treatment with hot water causes the KDNBF to crystallize out of solution.

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KDNBF is suitable for use as a primary high explosive.

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KING

See PERMISSIBLE EXPLOSIVE

• 10 •

KING NU-GEL

See PERMISSIBLE EXPLOSIVE

* * *

KING SPECIAL

See PERMISSIBLE EXPLOSIVE

* * *

KOMBINIROVANNAYA AZIDO-TETRILOVAYA

KOMBINIROVANNAYA AZIDO-TETRILOVAYA

Alternate Nomenclature:
None

Foreign Nomenclature:

The entry is given in the Russian nomenclature; there is no English equivalent. The literal translation of the term is "combined lead azide and tetryl."

Composition:

Lead Azide----- 0.15 to 0.20 gram top layer
Tetryl----- Up to 1.0 gram bottom layer

Tetryl sometimes is replaced by PETN or cyclonite.

Comments:

Kombinirovannaya azido-tetrilovaya is a Soviet explosive composition used in detonating caps.

KOMBINIROVANNAYA-GREMUCHERTUTNO-TETRILOVAYA

Alternate Nomenclature:
None

Foreign Nomenclature:

The entry is given in the Russian nomenclature; there is no English equivalent. The literal translation of the term is "combined mercuric fulminate and tetryl."

Composition:

Mercuric Fulminate----- 0.5 gram top layer
Tetryl----- Up to 1.0 gram bottom layer

Tetryl sometimes is replaced by PETN or cyclonite.

Comments:

Kombinirovannaya-gremuchertutno-tetrilovaya is a Soviet explosive composition used in detonating caps.

L-MIXTURE

L-MIXTURE

Alternate Nomenclature: Foreign Nomenclature:
The entry is given in the Russian: L-spiav
English equivalent of the
Russian nomenclature; there
is no corresponding U.S.
explosive.

Composition:

TNT----- 95%
Trinitroxylen----- 5%

Characteristics:

L-mixture is as sensitive to impact as TNT. It is, however, easier to detonate and requires a much smaller booster charge than does TNT. A booster is unnecessary if a strong detonator is used.

Uses:

L-mixture is a Soviet explosive composition which has been used for cast-loaded antitank mines and in demolition blocks.

L. ST.

See LEAD STYPHNATE

LACTOSE HEXANITRATE

See SUGAR NITRATE

LDNR

Alternate Nomenclature:
Lead Dinitroresorcinate

Composition:

PbC₆H₂N₂O₆ -- chemical compound containing the following percentages by weight of the elements: Lead----- 51.1%
Carbon----- 17.8%
Hydrogen---- 0.5%
Nitrogen---- 6.9%
Oxygen----- 23.7%

Characteristics:

LDNR is a red or yellow, press-loaded explosive material. It will explode when subjected to a temperature of 265°C for five seconds. It is only slightly hygroscopic. It is considerably more sensitive to impact than TNT.

Manufacture:

Dinitrosorescinol, prepared by treating resorcinol with nitrous acid, is oxidized to dinitroresorcinol. A solution of the dinitroresorcinol and sodium carbonate is combined with a lead nitrate solution. The precipitate is filtered and washed thoroughly.

Uses:

LDNR has been used in electric detonators.

LEAD AZIDE**See also AZIDES**Alternate Nomenclature:

None

Foreign Nomenclature:

French:	Azoture de plomb, nitrure de plomb
German:	Bleiazid
Italian:	Acido di piombo, azotimide di piombo
Japanese:	Chikka namari (Army), chikkaen (Navy)
Russian:	Acid svintsa
Spanish:	Acido de plomo, nitruro de plomo

Composition:

$Pb(N_3)_2$ -- chemical compound containing the following percentages by weight of the elements: Lead----- 71.14%
Nitrogen---- 28.86%

Characteristics:

Lead azide is a white to buff, press-loaded explosive material. It will not melt, but decomposes instead. It will explode when subjected to a temperature of 340°C for five seconds, and may detonate spontaneously at any temperature if crystals are over one millimeter in length. Lead azide contains no oxygen and detonation involves no combustion. Dry lead azide does not affect metals; moist lead azide corrodes zinc and copper rapidly, and with copper forms the extremely sensitive and dangerous compound copper azide. Unlike mercuric fulminate, lead azide cannot easily be dead-pressed. It is entirely stable and only slightly hygroscopic; it will not decompose during prolonged periods of storage at moderately high

LEAD AZIDE

temperatures. Lead azide is extremely sensitive to shock, friction, and heat. This sensitivity increases rapidly as crystal size increases to a point where spontaneous detonation may occur. Ordinarily lead azide is stored under water, although such storage of untreated lead azide may actually increase sensitivity since water may increase crystal size. For this reason, lead azide intended for long-term storage under water is usually dextrinated to permit safe storage.

Manufacture:

Lead azide, because of its sensitivity, is manufactured in small quantities, normally 300 grams of product. Sodium azide is prepared by treating sodamide (produced by interaction of sodium and aqueous ammonia) with nitrous oxide. The sodium azide is then reacted with lead acetate or lead nitrate, to produce lead azide as a white precipitate.

Uses:

Lead azide is used in primers and detonators. Since in pressed form it detonates less readily than in free form, lead azide for detonating caps and primers is coated with a layer of sensitizer to initiate its detonation.

Comments:

Lead azide is more efficient than mercuric fulminate, and is now used for many applications formerly filled by mercuric fulminate.

LEAD DINITRORESORCINATE

See LDNR

LEAD STYPHNATE

Alternate Nomenclature:

L. St.

Lead Trinitroresorcinate

Foreign Nomenclature:

French: Trinitroresorcinate
de plomb

German: Bleitr' nitroresorzinat

Italian: Stifnato di piombo,
trinitroresorcinato

di piombo

Russian: Stifnat svintsa,
trinitroresortsinat

svintsa, TNRS

Spanish: Trinitroresorcina
plomada

LEAD STYPHNATE

Composition:

$PbO_2C_6H(NO_2)_3$ or $PbC_6HN_3O_8$ -- chemical compound containing the following percentages by weight of the elements:

Lead----- 46.02%
Carbon---- 16.00%
Hydrogen--- 0.22%
Nitrogen--- 9.33%
Oxygen----- 28.43%

Characteristics:

Lead styphnate is a reddish-brown, press-loaded explosive which melts with explosive violence at 260° to 310°C. It will explode when subjected to a temperature of 282°C for five seconds. Lead styphnate is only slightly hygroscopic. It has a higher order of sensitivity than lead azide, but is a poor initiator; it cannot initiate the detonation of any of the military high explosives except PETN.

Manufacture:

Magnesium oxide is added to a suspension of styphnic acid in water, producing a solution of magnesium styphnate. This styphnate is mixed into a lead acetate solution. Dilute nitric acid is added after a precipitate is formed. The mixture is stirred and cooled until the lead styphnate crystals are formed; this precipitate is filtered, washed, and dried.

Uses:

Lead styphnate is used as an ingredient of the priming layer used as a coating for lead azide detonating charges.

LEAD TRINITRORESORCINATE

See LEAD STYPHNATE

LIQUID OXYGEN EXPLOSIVE

Alternate Nomenclature:

LOXE (see Comments below)

Foreign Nomenclature:

Hungarian: Oxilikvit

Russian: Oksilikvit

Composition:

Liquid oxygen explosives consist of a porous combustible material such as lampblack impregnated with liquid oxygen or liquid air, although fireproofed absorbent materials may be used without much change in characteristics.

Liquid Oxygen Explosive

Characteristics:

Liquid oxygen explosives are very sensitive to heat and shock. The liquid oxygen readily evaporates from the impregnated material. For this reason, they cannot be stored for long periods of time. Liquid oxygen explosives utilizing a fireproofed material will not readily detonate from shock, although they still can be detonated easily by a blasting cap.

Manufacture:

Manufacture of liquid oxygen explosives is simply a question of impregnating the absorbent material with liquid oxygen. The explosives ordinarily are prepared on the spot because of their sensitivity and the rapid evaporation of the liquid ingredient.

Uses:

Liquid oxygen explosives are used for aboveground mining purposes. They are never used underground. In the Soviet Union, they have been used in both commercial and military roles for some blasting operations.

Comments:

Liquid oxygen explosives rapidly lose their explosive character as the liquid oxygen or air evaporates. This is an important safety factor in cases where the explosive charge does not detonate.

The abbreviation LOXE for liquid oxygen explosives has not been standardized, and some preference has been expressed for the use of the abbreviation LOX. However, since LOX is normally used to refer to liquid oxygen, this dictionary uses the abbreviation LOXE to distinguish the mining explosive from the liquid material.

LOW-FREEZING AND NON-FREEZING DYNAMITES

See also DYNAMITE, NITROGLYCERIN

Alternate Nomenclature:
None

Foreign Nomenclature:
See DYNAMITE

Composition:

Low-freezing and non-freezing dynamites are similar to gelatin dynamites (see entry) but include in addition an ingredient which will lower the tendency of nitroglycerin explosive to freeze. As in the case of other dynamites, some low-freezing and non-freezing dynamites may contain ammonium nitrate. Representative compositions of low-freezing dynamites follow:

LOW-FREEZING AND NON-FREEZING
DYNAMITES

<u>Low-Freezing Gelatin Dynamite</u>	
Nitroglycerin-----	35%
Liquid Dinitrotoluene---	24%
Nitrocellulose-----	2%
Wood Meal-----	5%
Sodium Nitrate-----	30%

<u>Gelatine-Telsit</u> (a Swiss low-freezing ammonia dynamite)	
Nitroglycerin-----	22.0%
Dinitrotoluene-----	21.0%
Nitrocellulose-----	1.5%
Ammonium Nitrate-----	55.5%

In the case of non-freezing dynamites, several ingredients may be used to render the compositions non-freezing: dinitro-chlorhydrine, nitrated polymerized products of glycerin (such as tetranitroglycerin, dinitroacetin, dinitroformin), and nitrates of glycol. Representative compositions are listed below:

<u>Non-Freezing Gelatin Dynamite</u>	
Nitroglycerin-----	44%
Dinitrochlorhydrine----	19%
Nitrocellulose-----	2%
Sodium Nitrate-----	28%
Wood Meal-----	7%

<u>Non-Freezing Straight Dynamite</u>	
Nitroglycerin-----	15%
Tetranitroglycerin-----	15%
Wood Meal-----	10%
Sulfur-----	3%
Rosin-----	2%
Sodium Nitrate-----	55%

Characteristics:

Low-freezing dynamites usually freeze within a few degrees of 0°C and thus are suitable for exposure to moderate winter weather. Non-freezing dynamites usually can be subjected to temperatures down to -30°C without freezing. Low-freezing dynamites relying heavily upon dinitrotoluene are not as brisant as the equivalent dynamite. The use of nitrated polymerized products of glycerin reduce only slightly the strength of dynamite and when used in proper proportions aid appreciably in preventing the freezing of dynamites. The use of glycol nitrates gives even better results since these nitrates do not reduce sensitivity to ignition, they make the explosive non-freezing, and they relieve any shortage of glycerin. Other characteristics are like those for other dynamites.

LOW-FREEZING AND NON-FREEZING DYNAMITES

Manufacture:

The manufacturing process of low-freezing and non-freezing dynamites is the same as that for the equivalent dynamitos.

Uses:

Low-freezing and non-freezing dynamites are used for all blasting and mining operations where cold is liable to freeze ordinary untreated explosives.

LOW VELOCITY MILITARY DYNAMITE

See also MILITARY DINAMITE

Alternate Nomenclature:

LVD

Composition:

99.5/0.5 cyclonite/l-MA dye-----	17.5% (l-MA being 96% pure 1-methylamino-anthraquinone)
TNT-----	67.8%
Tripanthaerythritol-----	8.6%
68/32 Vistac No. 1/DOS Binder-----	4.1% (Vistac no. 1 being polybutene of low molecular weight; DOS being dicetylsebacate)
Cellulose Acetate, LH-1-----	2.0%

Characteristics:

Low velocity military dynamite is a pink, machine-loaded (by a Hall Packer) explosive. It will explode when subjected to a temperature of 480°C for five seconds. It is somewhat less strong than TNT and is less sensitive to impact. It is unaffected by friction sensitivity tests. It has good resistance to low temperatures and has functioned satisfactorily after being maintained at a temperature of -65°C for one day.

Manufacture:

The process of manufacture is classified Confidential.

Uses:

Low velocity military dynamite will be used for dynamite applications where a low detonation velocity is desirable.

Comments:

To date, low velocity military dynamite has only been prepared on a laboratory scale, and tests on the explosive are continuing.

LOXE

LOXE

See LIQUID OXYGEN EXPLOSIVE

LVD

See LOW VELOCITY MILITARY DYNAMITE

MALTOSE OCTONITRATE

See SUGAR NITRATE

MANNITOL HEXANITRATE

Alternate Nomenclature:
Nitromannite

Composition:

$C_6H_8N_6O_{18}$ -- chemical compound containing the following percentages by weight of the elements: Carbon----- 15.94%
Hydrogen---- 1.73%
Nitrogen---- 18.59%
Oxygen----- 63.69%

Characteristics:

Mannitol hexanitrate is a press-loaded explosive which melts at 112-113°C. It will explode when subjected to a temperature of 175°C for five seconds. It is extremely sensitive to impact, being comparable to lead azide in this respect. It is only slightly hygroscopic.

Manufacture:

Concentrated sulfuric acid is added to a previously-mixed solution of concentrated nitric acid and d-mannitol. The resulting precipitate is filtered and washed. The crude explosive material is purified and dried.

Uses:

Mannitol hexanitrate can be used as a secondary charge in detonators, and in blasting caps designed to be initiated by a fuze.

MANNOSE OCTONITRATE

MANNOSE OCTONITRATE

See SUGAR NITRATE

MEDIUM VELOCITY MILITARY DYNAMITE

Alternate Nomenclature:
MVD

Composition:

Cyclonite-----	75%
TNT-----	15%
Starch-----	5%
SAE No. 10 Oil-----	4%
Vistanex Oil Gel-----	1% (containing SAE no. 10 oil/Vistanex B-120XC/Navy D2 wax in 80/15/5 proportions)

Characteristics:

Medium velocity military dynamite is a buff, machine-loaded (by a Hall Packer) explosive. It is stronger than TNT and is less sensitive to impact (although it is more sensitive than low velocity military dynamite).

Manufacture:

Medium velocity military dynamite is manufactured on a standard dynamite production line. However, details of handling materials and techniques of manufacture are classified.

Uses:

Medium velocity military dynamite will be used for military excavation, demolition, and cratering operations for which standard high explosives are unsuitable.

MERCURIC FULMINATE

Alternate Nomenclature:
Fulminate of Mercury
Mercury Fulminate

Foreign Nomenclature:
French: Fulminate de mercure
German: Knallquecksilber
Hungarian: Higanyfulminát,
dúrranóhigany
Italian: Fulminato di mercurio
Japanese: Raikō (thunder mercury)
Russian: Gremuchaya rtut'
Spanish: Fulminato de mercurio,
fulminato mercurico

MERCURIC FULMINATE

Composition:

$\text{Hg}(\text{CN})_2$ or $\text{HgC}_2\text{N}_2\text{O}_2$ -- chemical compound containing the following percentages by weight of the elements:

Mercury----- 70.6%
Carbon----- 8.4%
Nitrogen---- 9.8%
Oxygen----- 11.2%

Characteristics:

Mercuric fulminate is a white (when pure) to grayish yellow, press-loaded, heavy crystalline explosive material. It will explode when subjected to a temperature of 210°C for five seconds. When dry, mercuric fulminate reacts vigorously with aluminum and magnesium, more slowly with copper, brass, and bronze. When wet, it reacts immediately with copper, zinc, brass, and bronze. It does not react with iron or steel. Dry mercuric fulminate is extremely sensitive to friction and impact, and is therefore always stored under water. It is practically nonhygroscopic. It is unstable and will explode when subjected to high temperatures (in the order of 100°C) for periods such as 16 hours. Prolonged exposure to tropical temperatures will cause slow deterioration and loss in detonation ability. Storage for three years at 35°C will cause mercuric fulminate to become inert; storage for 10 months at 50°C will produce the same result. It is, therefore, not suitable for use in the tropics.

Manufacture:

Mercury is dissolved in nitric acid, and the solution is mixed into ethyl alcohol. The resulting fulminate precipitate is repeatedly washed and, finally, purified.

Uses:

Mercuric fulminate is universally used as a detonator, either alone or more commonly mixed with 10 to 20% of potassium nitrate, thereby achieving greater efficiency.

Comments:

Mercuric fulminate is the only explosive known that can act as a primer, detonator, and booster in one charge. It is, however, less efficient than lead azide, and has been replaced by lead azide in many applications. For example, mercuric fulminate will not detonate TNT or explosive D unless an unsafe quantity is used.

MERCURY FULMINATE

See MERCURIC FULMINATE

MILITARY DYNAMITE

MILITARY DYNAMITE

See also LOW VELOCITY MILITARY DYNAMITE
and MEDIUM VELOCITY MILITARY DYNAMITE

Comments:

For details on Alternate Nomenclature, Characteristics, Manufacture, and Uses, see LOW VELOCITY MILITARY DYNAMITE and MEDIUM VELOCITY MILITARY DYNAMITE. Unlike commercial dynamites, military dynamites contain no nitroglycerin. They will not freeze in cold storage and will not exude in hot storage. They are less sensitive to friction and impact than commercial dynamites, and can be handled, transported, and stored with relative safety.

In addition to the low and medium velocity dynamites already referred to above, a military dynamite with a high velocity of detonation has been proposed. The nature of this explosive is classified.

MINEX

See TORPEX

MINOL

Alternate Nomenclature:
None

Composition:

Minols are a series of explosives developed by the British during World War II. The following three compositions were formulated:

	Minol-1	Minol-2	Minol-3
TNT-----	48%	40%	42%
Ammonium Nitrate-----	42%	40%	38%
Aluminum, Powdered-----	10%	20%	20%

The composition of Minol-2 may also be expressed as 50/50 amatol plus 25% powdered aluminum.

Characteristics:

Minol is a gray, cast-loaded explosive. It will ignite when subjected to a temperature of 435°C for five seconds. It is

comparable to TNT and tritonal in sensitivity to initiation, but is more sensitive to shock and is less brisant. It is unstable in the presence of moisture, however, since the ammonium nitrate and aluminum react with each other.

Manufacture:

Ammonium nitrate and aluminum are added to TNT which has been previously melted and which is maintained at 90°C. Minol can also be prepared by adding a specific quantity of aluminum to previously-prepared aluminum.

Uses:

Minol has been used as a bursting charge where TNT has been in short supply. Its advantages are not enough to warrant its use as anything but a TNT substitute.

MONOBEL

See PERMISSIBLE EXPLOSIVE

MVD

See MEDIUM VELOCITY MILITARY DYNAMITE

NAKOL'NAYA SMES'

Alternate Nomenclature:
None

Foreign Nomenclature:

The entry is given in the Russian nomenclature; there is no English equivalent. The literal translation of the term is "needle action composition."

Composition:

Lead Styphnate-----?	
Tetracene-----?	
Barium Nitrate-----?	
Antimony Trisulfide-----?	

The exact composition is not known.

Comments:

Nakol'naya smes' is a Soviet explosive mixture used as a percussion composition.

NAPCOGEL

NAPCOGEL

See PERMISSIBLE EXPLOSIVE

NATIONAL

See PERMISSIBLE EXPLOSIVE

NATRIALMATTRIT NO. 19

See also ALMATTRITE

Alternate Nomenclature:

None

Foreign Nomenclature:

The entry is given in the Russian nomenclature; there is no English equivalent.

Composition:

Sodium Chlorate---- 90%

Combustible----- 10% (containing 5% vaseline, 92.5% paraffin, 2.5% rosin)

Comments:

Natrialmatrit no. 19 is a Russian commercial explosive of the almatrite class (see entry). It has a brisance slightly higher than that of TNT.

NC

See NITROCELLULOSE

NG

See NITROGLYCERIN

NH (nonhygroscopic)

See FLASHLESS AND SMOKELESS COMPOSITION.

NITRO PENTAERYTHRITE

NITRO PENTAERYTHRITE

See PETN

NITROARABINOSE

See SUGAR NITRATE

NITROCELLULOSE

See also DOUBLE-BASE SMOKELESS PROPELLANT, GUNCOTTON, PYROCELLULOSE, SINGLE-BASE SMOKELESS PROPELLANT, TRIPLE-BASE SMOKELESS PROPELLANT

Alternate Nomenclature:

Cellulose Nitrate
Collodion
Guncotton
NC
Pyrocollodion
Pyrocotton

Foreign Nomenclature:

French: Pyroxylol
German: Nitrozellulose
Hungarian: Nitrocellulóz
Italian: Nitrocellulosa
Russian: Nitrokletchatka,
nitrotselulosa
Spanish: Nitrocelulosa,
piroxilina

Soviet NC types: KOLLOKSILIN,
11-12%N; PIROKOLLODION,
12.45%N; PIROKSILIN NO. 1,
12-13%N; PIROKSILIN NO. 2,
13%N and above.

U.S. NC types: PYROXYLIN or
COLLODION, 8-12%N; PYRO-
COLLODION, 12.45%N; PYRO-
CELLULOSE, 12.60%N; GUN-
COTTON, 13%N and above.

Composition:

Nitrocellulose is a mixture of groups of units of various degrees of nitration. Its overall chemical formula may be written as: $C_6H_{10-x}O_5(NO_2)_x$, where "x" usually is between 2 and 3.

Characteristics:

Nitrocellulose is white when pure, but appears more often as amber, brown, or black. It is manufactured in flakes, strips, sheets, pellets, or perforated cylindrical grains. The U.S. types listed above are universally recognized. Nitrocellulose consists of a mixture of nitrates obtained by nitrating cellulose. Nitrogen (N) content (and thereby explosives characteristics) varies according to variations in the condition for nitration. Nitrocellulose is inherently unstable; moreover, increases in nitrogen content increase this lack of stability. Unstability causes decomposition which produces nitrogen dioxide; the dioxide in turn attacks nitrocellulose and increases the rate of decomposition. Thus, the decomposition of nitrocellulose is a self-catalyzing process. The lack of stability can be partially overcome through improved nitration and purification procedures and better control of cellulose quality. Nitrocellulose is somewhat hygroscopic (decreasingly so with increasing nitrogen content). Absorption of moisture may cause significant changes in the propellant's ballistic value. Dry nitrocellulose is very sensitive to impact, friction, heat, and spark.

Manufacture:

The manufacture of pyrocellulose can be used as an example. Cellulose, obtained from either purified cotton linters or wood, is thoroughly dried and reacted with mixed acid. The crude nitrocellulose is separated from the resulting slurry by centrifuge. The nitrocellulose is boiled (for purification or stabilization) and packed. Other types of nitrocellulose are produced according to this basic pattern.

Uses:

Nitrocellulose is used in single-base smokeless propellants (nitrocellulose and non-explosive ingredients), double-base smokeless propellants (nitrocellulose and nitroglycerin), triple-base smokeless propellants (nitrocellulose, nitroglycerin, and nitroguanidine), and dynamites. Commercially, it is also used in pharmaceutical, laquer, and photographic products. Pyroxylin is the only form of nitrocellulose not used in explosives.

NITROGELATIN

See GELATIN DYNAMITE

NITROGELIN

NITROGELIN

See GELATIN DYNAMITE

NITROGLUCOSE

See SUGAR NITRATE

NITROGLYCERIN

Alternate Nomenclature:
Explosive Oil
Detonating Oil
Glyceryl Trinitrate
NG

Foreign Nomenclature:

French: Nitroglycérine, huile de Nobel, huile explosive
German: Nitroglycerin, sprengöl, glonoin
Hungarian: Nitroglycerin, robbanóolaj (explosive oil)
Italian: Nitroglycerina, olio esplosivo, olio detonante
Russian: Nitroglitserin
Spanish: Nitroglicerina, aceite explosivo

Also NITROGLYCERIN EXPLOSIVE:

French: Explosif à la nitroglycérine
German: Nitroglyzerinsprengstoff
Italian: Esplosivo alla nitroglicerina
Spanish: Explosivo de nitroglicerina

Also NITROGLYCERIN POWDER:

French: Poudre à base de nitroglycérine, poudre à la nitroglycérine
German: Nitroglyzerinpulver
Italian: Polvere a base di nitroglycerina
Spanish: Pólvora de nitroglicerina

Composition:

$C_3H_5(ONO_2)_3$ or $C_3H_5N_3O_9$ -- chemical compound containing the following percentages by weight of the elements:

Carbon-----	15.87%
Hydrogen-----	2.22%
Nitrogen-----	16.50%
Oxygen-----	63.41%

Characteristics:

Nitroglycerin is an oily colorless liquid when pure; the commercial product is yellowish or wine-yellow to brownish yellow. The labile form melts at 2.2°C , the stable form at 13.2°C . The liquid will explode when subjected to a temperature of 222°C for five seconds. Nitroglycerin is extremely sensitive to impact and friction, exceeding mercuric fulminate in this respect. It is the most hazardous explosive manufactured in relatively large quantities, and extreme care must be taken in the production process. It will detonate readily from the shock of iron striking iron or porcelain striking porcelain. Its sensitivity is increased markedly by heat. Large quantities will burn only for a short period of time since heat accumulation soon causes detonation. Despite internal stresses, nitroglycerin is stable at temperatures under 50°C , but higher temperatures cause decomposition which rapidly increases as the temperature increases. Nitroglycerin is nonhygroscopic.

Manufacture:

Glycerin is nitrated with mixed acid. Agitation and cooling are continued until reaching a temperature of about 15°C . The mixture is run off into a separating tank where the nitroglycerin floats to the surface and is collected. It is purified, washed, and put into storage. In the United States, the nitration process is carried out in steel or cast iron containers; in Europe it is carried out in lead containers. Nitration and purification in Europe are carried out by the Schmid and Biaffi continuous processes, which also use glycerin and mixed acid.

Uses:

Nitroglycerin is used extensively in propellant compositions, dynamites, and alone (with non-explosive materials) as a blasting explosive. Because of extremely dangerous handling difficulties, the use of straight liquid nitroglycerin is prohibited. If straight nitroglycerin is required, it is first mixed with an absorbent material such as "kieselguhr." In this form (i.e., dynamite) it may be packed, shipped, and handled, with relatively little danger.

NITROGLYCERIN

Recently, a trend has developed in the United States leading away from commercial nitroglycerin explosives to cheaper blasting explosives such as those based on ammonium nitrate.

NITROGLYCERIN PLOSIVE

See NITROGLYCERIN

NITROGLYCERIN POWDER

See NITROGLYCERIN

NITROGUANIDINE

Alternate Nomenclature:
Guanyl Nitramine
Picrite

Foreign Nomenclature:
British: Picrite

Composition:

$\text{H}_2\text{N.C}(:\text{NH})\cdot\text{NH}\cdot\text{NO}_2$ or $\text{CH}_4\text{N}_4\text{O}_2$ -- chemical compound containing the following percentages by weight of the elements:
Carbon----- 11.54%
Hydrogen---- 3.87%
Nitrogen---- 53.84%
Oxygen----- 30.75%

Characteristics:

Nitroguanidine is a colorless or white, crystalline, press-loaded explosive material melting at 232°C. It will detonate when subjected to a temperature of 275°C for five seconds. Nitroguanidine is far less sensitive than TNT to impact, friction, and initiation. It is less brisant than TNT and it has a relatively low heat of explosion (thus its ability to "cool" propellant compositions). Nitroguanidine is more stable than TNT and is nonhygroscopic.

Manufacture:

Nitroguanidine may be manufactured by two processes. Guanidine is reacted with nitric acid or the guanide is reacted with ammonium nitrate. Either reaction results in guanine nitrate, which is dehydrated to nitroguanidine with sulfuric acid.

NITROGUANIDINE

Uses:

Nitroguanidine is used primarily in propellant compositions (see TRIPLE-BASE SMOKELESS PROPELLANT). It was used during World War II by the Germans as a shell filling protector (from impact shock) and by the Italians in two amatol-type fillings.

Comments:

Nitroguanidine is desirable in certain propellants because of its ability to reduce temperatures of explosion and thus limit gun barrel wear. It also acts to a certain extent as a propellant stabilizer. Its use as a high explosive has virtually disappeared since, at best, it has been an inferior substitute for TNT.

NITROHYDRENE

See Uses under SUGAR NITRATE

NITROMANNITE

See MANNITOL HEXANITRATE

NITROSTARCH

See also GRENITE, NITROSTARCH
BLASTING EXPLOSIVE, TROJAN
EXPLOSIVE, NITROSTARCH DEMOLITION EXPLOSIVE

Alternate Nomenclature: Starch Nitrate

Foreign Nomenclature:

French:	Xyloidine
German:	Xyloidin
Italian:	Siloidina
Spanish:	Xiloidina, nitroalmidón
Russian:	Nitrokrahmal

Composition:

Nitrostarch is not a single well-defined compound, but rather a mixture of nitrates obtained by nitrating starch. No single chemical formula properly describes the compound.

NITROSTARCH

Characteristics:

Nitrostarch is a white, finely divided, pressed powder very similar in appearance to ordinary powder. It will ignite when subjected to a temperature of 400° F. for five seconds, and will burn with explosive violence. It will corrode iron and copper. Nitrostarch is highly explosive and will ignite from the smallest spark. It is slightly hygroscopic, absorbing 1 to 2% moisture. It is unstable in storage at elevated temperatures; it will decompose and cause spontaneous combustion. It is more sensitive to impact than TNT but less sensitive than either dry guncotton or nitroglycerin. Its sensitivity increases sharply when the material is warm and dry.

Manufacture:

Starch is purified and dried, and then nitrated with mixed acid. The resulting nitrostarch is evaporated from the spent acid, washed, and dried. Corn starch is the preferred raw material in the United States, although cassava seems to give a slightly more stable product.

Uses:

Straight nitrostarch is not used alone as an explosive because of its extreme sensitivity. It has been used to make Trojan explosives, grenite, and nitrostarch blasting explosives (see entries).

Comments:

Frequently, commercial and military explosives are referred to as "nitrostarch." They are, however, compositions of straight nitrostarch and other ingredients. As mentioned above, straight nitrostarch never is used alone. Since nitrostarch is a nitrate and not a nitro compound, the chemically correct nomenclature is "starch nitrate" not "nitrostarch." However, the latter has been generally adopted.

NITROSTARCH BLASTING
EXPLOSIVE

NITROSTARCH BLASTING EXPLOSIVE See also NITROSTARCH

Alternate Nomenclature:
None

Composition

The following composition can be considered as representative:

Nitrostarch-----	35.5%
TNT-----	15.0%
Barium Nitrate----	43.5%
Aluminum-----	3.0%
Graphite-----	2.0%
Paraffin-----	1.0%
Coal Dust-----	insignificant percentage
Dicyandiamide-----	insignificant percentage

Comments:

Nitrostarch blasting explosives are used in roles normally utilizing dynamites. The nitrostarch explosives have the advantage of being non-freezing and non-exuding. Nitrostarch blasting explosives are similar to nitrostarch demolition explosives (see entry).

NITROSTARCH DEMOLITION EXPLOSIVE See also NITROSTARCH

Alternate Nomenclature:
None

Composition:

Nitrostarch-----	49%
Barium Nitrate-----	40%
Mononitronaphthalene----	7%
Paranitroaniline-----	3%
Oil-----	1%

Characteristics:

Nitrostarch demolition explosive is a hand-tamped explosive material. It will detonate when subjected to a temperature of 105°C for five seconds. It is highly sensitive to impact, and will explode from the impact of a rifle bullet. It is slightly hygroscopic, absorbing about 2% moisture in an atmosphere of 30°C and 90% relative humidity.

NITROSTARCH DEMOLITION EXPLOSIVE

Uses:

As its name indicates, nitrostarch demolition explosive has been used principally in demolition charges. It is similar to nitrostarch blasting explosives (see entry).

NITROSUCROSE

See SUGAR NITRATE

NITROSUGAR

See SUGAR NITRATE

NON-FREEZING DYNAMITE

See LOW-FREEZING AND NON-FREEZING DYNAMITES

OSHITSUYAKU

Alternate Nomenclature:

None

Foreign Nomenclature:

The entry is given in the Japanese nomenclature; there is no English equivalent.

Composition:

Cyclonite----- 80%
Vegetable Oil---- 20%

Comments:

Oshitsuyaku is a Japanese explosive composition similar to U.S. composition B (see entry). It was used during World War II as a demolition agent.

OSHIYAKU

OSHIYAKU

Alternate Nomenclature:
None

Foreign Nomenclature:
The entry is given in the
Japanese nomenclature;
there is no English
equivalent.

Composition:

Picric Acid----- 90%
Wax----- 10%

Comments:

Oshiyaku is a Japanese explosive composition which was used during World War II as a bursting charge in artillery ammunition.

OTSU-B

Alternate Nomenclature:
None

Foreign Nomenclature:
The entry is given in the
Japanese nomenclature;
there is no English
equivalent.

Composition:

TNT----- 60%
Hexanitrodiphenylamine----- 24%
Aluminum Powder----- 16%

Comments:

Otsu-B is a Japanese explosive composition which was used during World War II as a bursting charge in torpedoes, mines, and depth charges.

P.A.

See PICRIC ACID

PENTAERYTHRITE TETRANITRATE

PENTAERYTHRITE TETRANITRATE

See PETN

PENTAERYTHRITOL TETRANITRATE

See PETN

PENTHRITE

See PETN

PENTOLITE

Alternate Nomenclature:
None

Foreign Nomenclature:
Japanese: Pentoriru

Composition:

Pentolite is a mixture of TNT and PETN in varying proportions. The most important composition contains TNT and PETN in a 50/50 proportion. Other compositions contain higher percentages of TNT. The descriptions below are for pentolite 50/50.

Characteristics:

Pentolite is a dirty white to light buff, press- or cast-loaded explosive which melts at 76°C. It will detonate when subjected to a temperature of 220°C for five seconds. Dry pentolite is highly compatible with metals, only slightly affecting zinc-plated steel. Wet pentolite slightly affects copper, brass, magnesium, magnesium-aluminum alloy, mild steel, and mild steel plated with copper, cadmium, zinc, or nickel. Pentolite is made in two grades; grade I is used for cast-loading and grade II for press-loading. The explosive is stable in storage, although less stable than straight PETN. High temperatures may cause some separation of PETN and TNT; temperatures above 50°C may cause the explosive to exude. Pentolite is 49% more efficient in shaped charges than TNT, and is more brisant than TNT.

Manufacture:

Two manufacturing methods are available. In the first, TNT is added to a suspension of PETN in water heated to above 80°C. The TNT melts and coats the PETN particles. Upon cooling the mixture, the TNT solidifies and the resulting

PENTOLITE

granules are collected and dried. In the second process, separate solutions of PETN-acetone and TNT-acetone are prepared. The solutions are mixed and poured into water. The precipitated pentolite solid is separated and dried.

Uses:

Pentolite is used as a bursting charge, shaped charge, in rockets, and in shaped demolition charges. During World War II, Japan used pentolite as a bursting charge for machinegun bullets (the Japanese incorporated high explosive fillers into machinegun bullets with calibers as small as 7.7-mm).

Comments:

The present trend is to replace pentolite with composition B because of the former's tendency to exude and separate, and its greater sensitivity over composition B.

PERMIGEL

See PERMISSIBLE EXPLOSIVE

PERMISSIBLE DYNAMITE

See PERMISSIBLE EXPLOSIVE

PERMISSIBLE EXPLOSIVE

PERMISSIBLE EXPLOSIVE

Alternate Nomenclature:
Permissible Dynamite
Safety Explosive

See also DYNAMITE, NITROGLYCERIN

Foreign Nomenclature:

Belgian: Explosif S. G. P.
(sécurité, grisou,
poussière),
explosif antigri-
souteux

British: Permitted explosive
(not to be confused
with authorized explosives
which are certified safe
only for handling and
transport)

French: Explosif antigrisouteux,
explosif de sécurité

German: Schlagwittersichere,
sicherheitssprengstoff,
sprengstoff, wetter-
dynamit

Hungarian: Engedélyezett, kezelés-
biztos, biztonsági,
kezelésbiztos dinamit,
zujtólégbiztos lőszer

Italian: Esplosivo ammissibile,
esplosivo di sicurezza

Russian: Bezopasnoye vzyvchatoye
veshchestvo

Spanish: Explosivo aprobado,
explosivo autorizado,
explosive de seguridad

Composition:

Permissible explosives are types of dynamites which usually contain ammonium nitrate and which are sensitized with nitrocellulose or gelatinized nitroglycerin (or less commonly with nitrostarch or TNT). They may contain a small amount of a "cooling" material such as sodium nitrate or chloride. The following composition gives the input limits for each ingredient:

Ammonium Nitrate-----	50 to 80%
Nitroglycerin-----	10 to 15%
Absorbent Material-----	Up to 10%
Other ingredients-----	Up to 40%

In some countries, major ingredients such as ammonium nitrate and nitroglycerin have been replaced by other explosives with satisfactory results.

Characteristics:

Permissible explosives are intended for the mining of coal where the accumulation of methane gas-air mixtures ("fire damp") and coal dust-air mixtures may be ignited by the high detonation temperatures of explosives not having certain characteristics. Permissible explosives, therefore, have comparatively low detonation temperatures; moreover, detonation products cool too rapidly to fire the ignitable atmosphere around them. Other characteristics are those listed for DYNAMITE.

Manufacture:

See DYNAMITE

Uses:

Permissible explosives are used universally in coal mines. The nongelatinous permisibles are well adapted for use in mines that are relatively dry; the gelatinous permisibles are better adapted for use in wet mines. They are designed especially for blasting rock in coal mines.

Comments:

In the United States, permissible explosives must be approved for use by the Bureau of Mines, Department of the Interior. Samples of proposed permissible explosives must be forwarded by the manufacturer to the Bureau, where extensive tests are conducted to determine the explosive's acceptability.

Permissible explosives that have been approved for use may be detonated only with electric detonators (not fuse and detonators), the detonating charge of which consists of a 1-gram mixture of 80 parts of mercuric fulminate and 20 parts of potassium chlorate (or their equivalent).

The following is a list of permissible explosives approved by the Bureau of Mines for use in the United States (as of 31 December 1957).

Nongelatinous Permissible Explosives:

American 2, 3-A, 4-A, 5, 11, 12, 12-A, 14-A, 21, 22, 23

American A

Apache Coal Powder A, B, H L.F.

Austin Red Diamond No. 1, 2, 3, 4, 5, 9-B, 9-C, 10-A, 11
Bituminite D

Black Diamond No. 5-A, 7, 7-A, 7-AA, 8, 9-A, 11, 11-A,
11-B, 12-B, 15, 55

PERMISSIBLE EXPLOSIVE

Black Diamond A, G
Black Diamond Special A, C
Coalite B, C, C-1, G, G-1, K, K-1, LL, LL-1, LS, LS-1,
M, M-1, MS, MS-1, S, S-1, T, T-1, 5-S, 7-R, 7-S.
Collier C
Duobel A, B, C, D, E, F
EL-446, 447, 454
Independent A, B, C, C-1, D, E, F, G, H
King No. 5-A, 7, 7-A, 7-AA, 8, 9, 5-A, 11, 11-A, 11-B,
12-B, 15, 55
King No. A, G
King Special A, C
Lump Coal C, CC
Miners' Friend No. 2
Monobel A, AA, B, C, D, E
National A, A-1, B, C, D, E, F, F-1, G, H
Peerless No. 2
Red Crown B-3, D-2
Red HA, HB, HC, HD, HF, HL
Super-X No. 2, 2-A, 3, 3-A, 5, 7, 8, 9, 11
Super-X Big Coal D
Super-X Big Red No. 7-C
Wesco Coal Powder No. 1

Gelatinous Permissible Explosives:

Austin Red-D-Gel
Black Diamond Nu-Gel No. 4
Gel-Coalite W, X, Z
Gel-Coalite No. 3
Gelobel A, AA, C
Hercogel 2
Hercogel A
Independent Gel-A
King Nu-Gel No. 4
Napcogel No. 1
Permigel A, B
Super-X Gel
Super-X Gel A, B

Permissible explosives are not normally imported or exported, unless a country has no dynamite production facilities at all. Therefore each nation has developed and standardized its own types of permissible explosives.

PETN

PETN

<u>Alternate Nomenclature:</u>	<u>Foreign Nomenclature:</u>
Nitro Pentaerythrite	German: Nitropentaerythrit,
Pentaerythrite Tetranitrate	pentrit
Pentaerythritol Tetranitrate	Italian: Pentrite
Penthrite	Japanese: Shoeiyaku
Tetranitropentaerythritol	Russian: Tetraertritol nitrat, TEN

Composition:

$C(CH_2ONO_2)_4$ or $C_5H_8N_4O_{12}$ -- chemical compound containing the following percentages by weight of the elements: Carbon----- 13.00% Hydrogen---- 2.55% Nitrogen---- 17.72% Oxygen----- 60.73%

Characteristics:

PETN is a white or light buff, press-loaded explosive material. The pure explosive melts at 141.3°C; commercial grades melt at from 138.0° to 138.5°C. PETN will detonate when subjected to a temperature of 225°C for five seconds. The dry material does not react with metals; wet PETN will affect copper, brass, magnesium, magnesium-aluminum alloy, mild steel, mild steel coated with acid-proof black paint, and mild steel plated with cadmium, copper, nickel, or zinc. Wet PETN will also slightly affect aluminum after prolonged storage. PETN is graded into four classes (classes A, B, C, and D) according to its granulation (i.e., size of its crystals). It is extremely stable when no acid is present, and will show no decomposition if stored for long periods at temperatures ranging up to 100°C. However, the presence of only 0.01% free acid causes rapidly increasing decomposition. PETN is one of the strongest known explosives, being 95 to 96% more powerful than TNT. It is more or less insensitive to friction, less sensitive than nitroglycerin to impact. It is, however, extremely sensitive to initiation.

Manufacture:

PETN may be manufactured by one of two methods; one with and one without sulfuric acid. When using sulfuric acid, pentaerythritol is reacted with nitric acid. Sulfuric acid is added to complete the separation of PETN. The process not using sulfuric acid is the preferred manufacturing process in the United States. In this preferred method, pentaerythritol is added to 96% nitric acid. After 20 minutes, this solution is added to cold water and the precipitated PETN is filtered out. After rewashing, the PETN is dissolved in acetone, the solution is filtered, and the PETN is precipitated by the addition of cold water. PETN generally is not dried before use.

PETN

Uses:

Class A PETN is used in boosters and detonating fuse (Primacord); class B PETN is used as an ingredient for priming compositions; class C PETN is used in the manufacture of pentolite (see entry); and class D PETN is used in detonators and blasting caps.

PETN/WAX

Alternate Nomenclature:

None

Composition:

PETN-----	95%	--	90%	--	87%	--	82%	--	70%	--	60%	--	50%	--	35%
Wax-----	5%	--	10%	--	13%	--	18%	--	30%	--	40%	--	50%	--	65%

Comments:

PETN/wax compositions have been used primarily by Germany and Italy as boosters or press-loaded bursting charges, depending upon the amount of wax.

PICRATOL

Alternate Nomenclature:

None

Composition:

Explosive D-----	52%
TNT-----	48%

Characteristics:

Picratol is a brown-yellow, cast-loaded explosive material. It will detonate when subjected to a temperature of 285°C for five seconds. Picratol is insensitive to shock, and its brisance lies between that of explosive D and TNT. It is nonhygroscopic. When stored for long periods of time at high temperatures, the explosive exhibits a slight reaction between the explosive D and TNT. At ordinary temperatures, however, picratol is entirely stable.

PICRATOL

Manufacture:

TNT is melted and heated to over 90°C. Explosive D is added without being preheated. The resulting thick slurry is cooled to about 85°C and is cast-loaded into ammunition.

Uses:

Picratol is used as a standard filler for armor-piercing bombs.

Comments:

Picratol was developed during World War II as an inexpensive cast-loaded substitute to explosive D, which had to be press-loaded under pressures running up to 12,000 psi. It has proven quite satisfactory.

PICRIC ACID

See also AROMATIC NITRO COMPOUNDS

Alternate Nomenclature:

P. A.

TNP

Trinitrophenol

Foreign Nomenclature:

British: Lyddite

French: Acide picrique, tri-nitrophénol, mélinite

German: Pikrinsäure, trinitrophenol, melinit, bittersäure, Fp 88, Füllpulver 1608

Hungarian: Pikrinsav, trinitrofenol

Italian: Acido picrico, trinitrofenolo, pertite

Japanese: Ōshokuyaku (Army), shimose bakuyaku (Navy)

Russian: Pikrinovaya kislota, melinit, M.

Spanish: Ácido pícrico, trinitrofenol

Composition:

$C_6H_2(NO_2)_3OH$ or $C_6H_3N_3O_7$ -- chemical compound containing the following percentages by weight of the elements:

Carbon----- 31.45%

Hydrogen---- 1.32%

Nitrogen---- 18.33%

Oxygen----- 48.89%

PICRIC ACID

Characteristics:

Picric acid is a light to bright yellow, press-loaded explosive which melts at from 122° to 123°C. It will detonate when subjected to a temperature of 320°C for five seconds. Picric acid reacts with all metals except aluminum and tin. Its reactions with copper, brass, lead, and iron are especially dangerous since the compounds resulting from these reactions are extremely sensitive. Picric acid was the first high explosive to be cast-loaded, but its melting point is too high for safe casting; the melting point can be lowered by the addition of other nitro explosives. Picric acid is about as sensitive to shock, friction, and initiation as TNT. It is more powerful than TNT, and will produce a greater number of fragments than TNT when both explosives are loaded with equal densities in fragmentation shells. Picric acid is nonhygroscopic, and is highly stable; long periods of storage at ordinary temperatures have caused no measurable change in the explosive.

Manufacture:

Picric acid may be manufactured from benzene through three processes: the phenol process, the chlorbenzene process, and the catalytic process. (1) In the phenol process phenol, prepared by the hydrolysis of benzene sulfonic acid, is treated with sulfuric acid to yield phenol sulfonic acid which in turn is treated with nitric acid. The solution is cooled and the crystallized picric acid is separated, washed, and dried. (2) In the chlorbenzene process, benzene is treated with gaseous chlorine, yielding monochlorbenzene. The product is purified and nitrated to give dinitrochlorbenzene. The latter, on treatment with lime or soda, loses its chlorine content and becomes calcium or sodium dinitrophenolate, which on acidifying is converted to dinitrophenol. This in turn is nitrated to picric acid. (3) In the catalytic process, benzene is converted into either dinitrophenol or picric acid direct in one operation by means of weak nitric acid in the presence of mercuric fulminate which acts as a catalyst.

Uses:

Picric acid is used by the United States chiefly in the manufacture of explosive D (see entry); by Germany as a booster; by Japan as a booster and bursting charge; and by France in the manufacture of tridite and trimonite (see entries). It may be used as a bursting charge by countries where toluene is in short supply. However, such usage usually requires a non-metallic shell lining for projectiles.

PICRITE

PICRITE

See NITROGUANIDINE

PIPE

Alternate Nomenclature:

None

Composition:

PETN----- 81%
Gulf Crown E. Oil---- 19%

Characteristics:

PIPE is a hand-tamped, nonhygroscopic high explosive. It is somewhat more sensitive to impact than TNT, but is unaffected by a direct hit of a rifle bullet. It is insensitive to friction, and is stable in storage.

Manufacture:

PIPE is manufactured very simply through a mechanical mixing of the PETN and oil.

Uses:

PIPE is used as a plastic demolition explosive.

PLASTIC EXPLOSIVES

See COMPOSITIONS C, C-2, C-3, and C-4,
PIPE, PVA-4, RIPE

PLX-100 and PLX-95/5

Alternate Nomenclature:

None

Composition:

Nitromethane-----	100%	PLX-100	PLX-95/5
Ethylenediamine-----	0%	5%	5%

PLX-100, PLX-95/5

Characteristics:

PLX is a light yellow, liquid explosive with a melting point of -29°C and a boiling point of 101°C (figures for PLX-100). The explosive, therefore, is used in its liquid state. Both types of PLX will explode when subjected to a temperature of 430°C for five seconds. PLX will corrode brass, but it does not react with stainless and mild steel. It is somewhat less sensitive to impact than TNT, and it will not detonate from the impact of a rifle bullet.

Manufacture:

The explosive (95/5 type) is mixed only when ready to use. The components are stored separately.

Uses:

PLX is used for minefield clearance. For this purpose, the liquid is placed in glass containers.

POTASSIUM DINITROBENZFORUXAN

See KDNBF

PROPELLANTS

See COMPOSITE PROPELLANT, DOUBLE-BASE SMOKELESS PROPELLANT, PROPELLANTS--FOREIGN, SINGLE-BASE SMOKELESS PROPELLANT, SMOKELESS PROPELLANT, SOLID ROCKET PROPELLANT, TRIPLE-BASE SMOKELESS PROPELLANT

PROPELLANTS--FOREIGN

PROPELLANTS--FOREIGN

For general information on classes of propellants not discussed under this entry, see the references given for PROPELLANTS.

Modern foreign propellants do not differ greatly from the smokeless propellants used by the United States. All have a nitrocellulose base (with the exception of some rocket propellants), and may be classed as single-, double-, and triple-base propellants. Major differences from United States compositions, such as was employed by Germany during World War II, arise primarily from the scarcity of glycerin rather than improved characteristics.

Smokeless propellants have been manufactured by practically all nations, large and small. No definite pattern of production for the several types can be established, although countries manufacturing only small arms ammunition have tended to concentrate on the production of single-base propellants because of their greater ease of manufacture, the availability of raw materials, and the relatively little difference between the performance of single-base and double-base types when used in small arms ammunition.

The production of triple-base propellants (sometimes called double-base propellants with nitroguanidine) has been much more restricted than double-base types. Outside of the United States, only Great Britain and Germany are known to have employed triple-base types in any quantity. The advantages of triple-base propellants are not as easily understood as are the advantages of other explosives, since they occur primarily within the gun (in the form of cooler burning temperatures and thus less gun barrel erosion) rather than in the performance characteristics of the projectile.

British Propellants

British propellants are quite similar to United States smokeless propellants. The British leaned heavily on double-base types (see CORDITE), but the necessities of World War II forced some modifications in propellant compositions, bringing both single-base (such as N.C.T.) and triple-base compositions into extensive use. Examples of British compositions are given below:

PROPELLANTS--FOREIGN

	<u>Single-Base</u>	<u>Double-Base</u>	<u>Triple-Base</u>
Nitrocellulose-----	94.7%	77.90%	20.0%
Nitroglycerin-----	...	14.05%	19.0%
Dinitrotoluene-----	4.1%	...	...
Nitronaphthalene-----	...	5.40%	...
Nitroguanidine-----	...	...	53.7%
Tin-----	0.5%	...	...
Graphite-----	0.2%	0.25%	...
Cryclite-----	...	...	0.3%
Centralite-----	0.5%	1.60%	6.0%

French Propellants

French propellants are of the common single-base (poudre B and poudre B.N.) and double-base types. They differ, however, in that they normally contain more than one nitration level of nitrocellulose in each composition. The scarcity of glycerin has restricted the production of double-base propellants, and consequently France relies more heavily upon single-base types than do other European nations. Examples of French compositions are given below:

	<u>Poudre B</u>	<u>Poudre B.N.</u>	
Guncotton-----	68%	41%	
Collodion Cotton-----	29%	28%	Forms of nitrocellulose
Barium Nitrate-----	...	19%	
Potassium Nitrate-----	...	8%	
Vaseline-----	2%	...	
Soda Ash-----	...	2%	
Volatiles-----	1%	0%	

German Propellants

German propellants are of the single-, double-, and triple-base types. The double- and triple-base compositions, however, differ from United States and British types in that during World War II nitroglycerin was often replaced by DEGN (see entry) and TEGN (see entry). German single-base propellants conformed more closely to United States types, although there were some German compositions which included PETN. Extensive use was made of stabilizers; in many cases, two or more stabilizers were used in the same composition. Examples of German propellant compositions are given below:

	<u>Single-Base</u>			
Nitrocellulose-----	95.9%	34.0%	98.1%	96.0%
Dibutylphthalate-----	...	...	...	1.1%
Potassium Sulfate-----	...	...	...	1.0%
PETN-----	...	64.7%	...	...
Graphite-----	0.5%	...	0.1%	1.3%
Camphor-----	...	...	1.8%	...
Contra'ite-----	3.6%	0.4%	...	1.2%
Diphenylamine-----	...	...	...	0.2%

PROPELLANTS--FOREIGN

Double-Base

Nitrocellulose-----	70.4%	63.4%	60.5%	58.0%
Nitroglycerin-----	27.3%	33.0%	...	...
DEGN-----	...	...	26.0%	...
TEGN-----	...	...	...	25.1%
Dinitrotoluene-----	...	...	1.0%	...
Nitronaphthalene-----	...	...	2.5%	...
Hydrocellulose-----	...	...	3.0%	...
Potassium Sulfate-----	0.6%	...	...	1.0%
Graphite-----	...	0.1%	0.10%	0.1%
Magnesium Oxide-----	...	...	0.15%	0.8%
Centralite-----	1.5%	...	3.75%	12.0%
as-Diphenylurea-----	0.2%	0.2%	...	...
Ethylphenylurethane-----	...	1.5%	...	...
Diphenylurethane-----	...	1.8%	...	...

Triple-Base

Nitrocellulose-----	43.5%
DEGN-----	18.6%
Nitroguanidine-----	30.0%
Graphite-----	0.1%
Magnesium Oxide-----	0.3%
Acardite-----	0.5%
Diphenylurethane-----	3.25%
Methylphenylurethane---	3.75%

Italian Propellants

Italian propellants in use during World War II were very similar to the propellants used in Germany. The Italians, however, did not employ triple-base propellants. Like the Germans, the Italians replaced nitroglycerin with DEGN and employed several stabilizers in some of their compositions. Examples of Italian propellant compositions are given below:

	Single-Base	Double-Base	Double-Base
Nitrocellulose-----	97.0%	62.0%	...
Cellulose Acetate-Nitrate-----	...	...	63.5%
Nitroglycerin-----	...	33.0%	...
DEGN-----	...	...	27.0%
Cellulose Acetate-----	...	...	5.0%
Graphite-----	...	0.3%	...
Petroleum Jelly-----	...	2.0%	...
Centralite-----	2.0%	2.6%	4.5%
Diphenylamine-----	1.0%	...	...
as-Diphenylurea-----	...	0.1%	...

PROPELLANTS--FOREIGN

Japanese Propellants

Japanese propellants used during World War II were restricted almost exclusively to single-base types on account of the scarcity of glycerin and glycerin substitutes (glycols). Only a few double-base propellants were produced. Examples of Japanese propellant compositions are given below:

	<u>Single-Base</u>	<u>Single-Base</u>	<u>Double-Base</u>
Nitrocellulose-----	93.2%	92.5%	72.0%
Nitroglycerin-----	...	...	19.5%
Dinitrotoluene-----	5.5%	5.0%	...
Tin-----	...	2.0%	...
Potassium Nitrate-----	...	...	2.5%
Graphite-----	0.3%	...	...
Diphenylamine-----	1.0%	0.5%	...
as-Diphenylurea-----	...	...	6.0%

Soviet Propellants (Metalel'nyye vzryvchatyye veshchestva)

Soviet propellants are of the standard single- and double-base types, and are similar to those in use in other countries. Before World War II, only single-base propellants were in use. Since then, single-base types have been limited to small arms ammunition and some artillery ammunition, while double-base types have been used in artillery ammunition and rockets. The Soviet Union has not used any triple-base propellants or any glycerin substitutes. Examples of Soviet propellant compositions are given below:

	<u>Single-Base, Artillery</u>	<u>Single-Base, SAA</u>
Nitrocellulose-----	98.9%	99.3%
Graphite-----	...	...
Camphor-----	...	...
Diphenylamine-----	1.1%	0.7%
	98.7%	96.9%
	...	0.3%
	...	0.8%
	1.3%	2.0%

Double-Base, Antitank

Nitrocellulose-----	64.4%
Nitroglycerin-----	20.8%
Dinitrotoluene-----	3.9%
Graphite-----	0.3%
Petroleum Jelly-----	2.6%
Centralite-----	1.3%
as-Diphenylurea-----	6.7%

PTX-1

PTX-1

Alternate Nomenclature:

None

Composition:

Cyclonite-----	30%
Tetryl-----	50%
TNT-----	20%

Characteristics:

PTX-1 is a light yellow, cast-loaded explosive which melts (eutectically) at 67°C. It does not react with aluminum or mild steel. It is roughly twice as sensitive to impact as TNT and may explode from the impact of a rifle bullet. It is nonhygroscopic and stable in storage.

Manufacture:

PTX-1 may be prepared by adding wet cyclonite to melted tetrytol 40/60. The mixture is heated and stirred until all water is evaporated and the composition is uniform. PTX-1 may also be prepared by adding tetryl to composition E.

Uses:

PTX-1 may be employed in land mines and for demolition charges.

Comments:

PTX-1 is an experimental explosive designed to overcome the sensitivity of tetrytol and its tendency to exude.

PTX-2

Alternate Nomenclature:

None

Composition:

Cyclonite-----	44% - 41%
PETN-----	28% - 26%
TNT-----	28% - 33%

Characteristics:

PTX-2 is a dirty white to light buff, cast-loaded explosive which melts (eutectically) at 75°C. It is much more sensitive to impact than TNT, more so than PTX-1. It is, however, less sensitive to rifle bullet impact than PTX-1. It is nonhygroscopic.

PTX-2

Manufacture:

PTX-2 may be prepared by adding wet cyclonite to melted pentolite (30/70). The mixture is heated and stirred until all water is evaporated and the composition is uniform.

PTX-2 may also be prepared by adding wet PETN to composition B.

Uses:

PTX-2 may be employed in shaped charge and fragmentation shells.

Comments:

PTX-2 is an experimental explosive designed to overcome the sensitivity of pentolite.

PVA-4

Alternate Nomenclature:

None

Composition:

Cyclonite-----	90 to 92%
Polyvinyl Acetate----	8 to 6%
Dibutylphthalate----	2 to 2%

Characteristics:

PVA-4 is a white, press-loaded or extruded explosive. It will explode when subjected to a temperature of 375°C for five seconds. It is quite sensitive to impact and will be affected by a rifle bullet 80% of the time. It is slightly hygroscopic.

Manufacture:

A solution of polyvinyl acetate and dibutylphthalate in acetone is added to a hot water slurry of cyclonite. The resulting PVA-4 is stirred for uniformity of composition.

Uses:

PVA-4, a semi-plastic composition, is suitable for use as a demolition charge explosive.

Comments:

PVA-4 of 90% cyclonite was originally prepared by Canada.

PYROCELLULOSE

See NITROCELLULOSE

PYROCOLLODION

PYROCOLLODION

See NITROCELLULOSE

PYROCOTTON

See NITROCELLULOSE

PYRONITE

See TETRYL

PYROXYLIN

See NITROCELLULOSE

RDX

See CYCLONITE

RED CROWN (series)

See PERMISSIBLE EXPLOSIVE

RED H (series)

See PERMISSIBLE EXPLOSIVE

RIPE

Alternate Nomenclature:
None

Composition:

Cyclonite----- 85%
Gulf Crown M Oil---- 15%

RIPE

Characteristics:

RIPE is a white, hand-tamped explosive. Its strength is some 18% greater than that of TNT. It is practically nonhygroscopic.

Manufacture:

RIPE is very simply manufactured through a mechanical mixing of the cyclonite and oil.

Uses:

RIPE is used as a plastic demolition explosive.

ROCKET PROPELLANT

See SOLID ROCKET PROPELLANT

RUSSIAN ALLOY

Alternate Nomenclature:

The entry is given in the English equivalent of the Russian nomenclature; there is no corresponding U.S. explosive.

Foreign Nomenclature:

Japanese: Onayaku
Russian: Ruskii splav

Composition:

	Russian	Japanese
Picric Acid-----	51.5%	50% or 30%
Dinitrophthalene-----	48.5%	50% 20%

Comments:

Russian alloy is an explosive composition which has been used by the Soviet Union as a bursting charge in land mines, bombs, and artillery ammunition, and by Japan during World War II as a bursting charge in artillery ammunition.

RUSSIAN MIXTURE

Alternate Nomenclature:

The entry is given in the English equivalent of the Russian nomenclature; there is no corresponding U.S. explosive.

Foreign Nomenclature:

Russian: Ammonitol, russkaya smes'

RUSSIAN MIXTURE

Composition:

Ammonium Nitrate-----	50%
TNT-----	38%
Trinitroxylen-----	32%

Comments:

Russian mixture is a Soviet explosive composition. Its uses are not known, but it may be used as a bursting charge or a demolition explosive. Because of its ammonium nitrate content, it is hygroscopic and therefore not entirely satisfactory.

SAFETY EXPLOSIVE

See PERMISSIBLE EXPLOSIVE

SHOAN BAKUYAKU

See also Foreign Nomenclature under DYNAMITE

Alternate Nomenclature:

None

Foreign Nomenclature:

The entry is given in the Japanese nomenclature; there is no corresponding U.S. explosive.

Composition:

Ammonium Nitrate-----	79%
Dinitronaphthalene-----	10%
Sodium Chloride-----	10%
Sawdust-----	1%

Comments:

Shoan bakuyake is a Japanese explosive composition which was used during World War II in demolition charges.

SILVER AZIDE

SILVER AZIDE

Alternate Nomenclature:
None

See also AZIDES

Foreign Nomenclature:
French: Azoture d'argent,
nitruie d'argent
German: Silberazid
Italian: Acido d'argento,
azoixida d'argento
Spanish: Ácido de plata,
nitruro de plata

Composition:

AgN_3 -- chemical compound containing the following percentages
by weight of the elements: Silver----- 72.0%
Nitrogen---- 28.0%

Characteristics:

Silver azide is a white to gray, press-loaded explosive
melting at 251°C. It will detonate when exposed to a
temperature of 290°C for five seconds. Like lead azide,
silver azide contains no oxygen and detonation involves no
combustion. It is non-volatile and practically nonhygro-
scopic. It is somewhat more sensitive than lead azide.
Like lead azide, silver azide is stored wet.

Manufacture:

A solution of sodium azide is added slowly to a solution of
silver nitrate which is being rapidly stirred. The resulting
silver azide precipitate is filtered out of solution.

Uses:

Silver azide may be used as an initiating explosive, although
its use thus far has been very limited.

SINGLE-BASE COLLOIDED PROPELLANT See SINGLE-BASE SMOKELESS PROPELLANT

SINGLE-BASE POWDER

See SINGLE-BASE SMOKELESS PROPELLANT

SINGLE-BASE SMOKE-
LESS PROPELLANT

SINGLE-BASE SMOKELESS PROPELLANT See also GUNCOTTON, NITROCELLULOSE, PROPELLANTS--FOREIGN, SMOKELESS PROPELLANT, and specific types listed under Composition below

Alternate Nomenclature:
Single-Base Colloided
Propellant
Single-Base Powder

Foreign Nomenclature:
British: N.C.T. (Nitrocellulose,
Tubular)
Russian: Piroksilinovyye
porokh
Spanish: Pólvora de base única,
pólvora nitrocelulósica

Composition:

Single-base propellants contain nitrocellulose as their principal ingredient. In addition they contain a stabilizer, and also may contain inorganic nitrates, nitrocompounds, and non-explosive materials such as metallic salts, metals, carbohydrates, and dyes.

Single-base propellants can be grouped into the following types:

Fyrocellulose (powder)
E. C. Powder
Flashless and Smokeless Compositions
Small Arms Propellant

Each of the above is discussed under a separate entry. For foreign compositions, see PROPELLANTS--FOREIGN.

Characteristics:

Single-base propellants usually are amber, brown, or black in color and are manufactured in as many forms as double-base propellants, i.e., flakes, strips, sheets, spheres, pellets, tubes, and perforated cylindrical grains (normally with one or seven perforations). The amount of energy and gas liberated by single-base propellants is determined by the degree of nitration (as measured by the nitrogen content). Single-base propellants are inherently unstable, and stabilizers are required to bring the stability of these propellants up to practical limits. These propellants are more difficult to stabilize than are double-base propellants. Single-base propellants are hygroscopic; the presence of moisture in the propellant will change the muzzle velocity and thus the predictable accuracy of projectiles.

SINGLE-BASE SMOKELESS PROPELLANT

Manufacture:

Nitrocellulose is first compressed to squeeze out a portion of excess water. It is then impregnated with alcohol which displaces the remaining water and dehydrates the material. The resulting dehydrated block is broken up and mixed with ether to form a colloid. At this stage the stabilizer, usually diphenylamine, is added. The colloid is again pressed into a block and is forced through a "macaroni press" where it emerges in strands similar in appearance and size to macaroni. The colloid is re-blocked as long perforated tubes (if this is the form desired). The grains undergo a solvent recovery process (to collect ether and alcohol) and are dried.

Uses:

Single-base propellants have been used in most types of ammunition. However, many propellant requirements are better filled by double-base propellants, and single-base propellants have been replaced by double-base types in many applications. In countries where nitroglycerin is in very short supply, single-base propellants may be used in ammunition with passable results.

Comments:

Since single-base propellants are colloids and not powders, the use of the phrase "single-base powder" is not correct. The term "single-base colloided propellant" for these propellants is coming into increasingly wide usage since it is more accurate in its description (the propellants are not completely smokeless).

SMALL ARMS PROPELLANT

See also SINGLE-BASE SMOKELESS PROPELLANT

Alternate Nomenclature:

None

Composition:

Since small arms propellants are a type of single-base propellant, they all contain nitrocellulose as their principal ingredient, plus varying amounts of stabilizers and other non-explosive ingredients. Typical compositions are listed below:

SMALL ARMS PROPELLANT

	IMR	I	II	III	IV
Nitrocellulose-----	97.4% ^a	99.3% ^b	98.3% ^b	99.0% ^c	98.95% ^d
Tin-----	2.0%	...	...	...	...
Potassium Sulfate----	...	...	...	1.0%	...
Diphenylamine-----	0.6%	0.7%	0.7%	1.0%	1.05%
				0.4%	

^a 3.15% nitrogen

^b 3.15% or 13.25% nitrogen

^c 13.10% nitrogen minimum

^d 12.95% nitrogen

To all the above compositions, a glaze of graphite and a coating of dinitrotoluene is applied to the grains.

Characteristics:

Smokeless propellants for small arms are usually glazed with graphite to facilitate machine loading and to prevent the accumulations of large charges of static electricity. Small arms propellants have a black polished appearance. They have a high order of stability and are particularly resistant to the effects of moisture because of the dinitrotoluene coating. Since the propellant grains are small, they ignite more readily and burn more freely than artillery propellants. However, when moisture is present or abnormal temperatures prevail, the small grains are subject to more rapid deterioration than the larger grains. Many small arms propellants are nearly as sensitive to friction as black powder.

Manufacture and Uses:

See SINGLE-BASE SMOKELESS PROPELLANT

SMOKELESS PROPELLANT

See also COMPOSITE PROPELLANT, DOUBLE-BASE SMOKELESS PROPELLANT, SINGLE-BASE SMOKELESS PROPELLANT, TRIPLE-BASE SMOKELESS PROPELLANT

Alternate Nomenclature:

Colloided Propellant
Smokeless Powder

Foreign Nomenclature:

Russian: Bezdyomyi porokh

SMOKELESS PROPELLANT

Comments:

Smokeless propellants may be divided into four main classes:

Single-Base Smokeless Propellant

Double-Base Smokeless Propellant

Triple-Base Smokeless Propellant

Composite Propellant

Entries under the above headings give specific details on Composition, Characteristics, Manufacture, and Uses.

All smokeless propellants with the exception of composite propellants contain nitrocellulose as one of the "bases." Single-base propellants have nitrocellulose as their active explosive; double-base propellants contain nitrocellulose and nitroglycerin as the two bases; and triple-base propellants contain nitrocellulose, nitroglycerin, and nitroguanidine. Triple-base propellants have often been treated as a type of double-base propellants; however, these propellants contain three active explosives in their composition and their characteristics differ considerably from the characteristics of double-base propellants. They are, therefore, properly treated as a separate class of propellants.

Smokeless propellants have replaced black powder in all but the crudest propellant applications. They are used in all types of infantry and artillery ammunition and in many types of rocket motors.

The term "colloidal propellant" for smokeless propellants is coming into increasingly wide usage since it is more accurate in its description than is the term "smokeless propellant" (these propellants are colloids and they are not completely smokeless).

SOLID ROCKET PROPELLANT

Alternate Nomenclature:

None

Composition:

Solid rocket propellants may utilize a number of compounds, some of which are classified Confidential or above when used in propellant applications. In general, all solid rocket propellants contain a fuel and an oxidizer in the proper proportions for sustained combustion.

SOLID ROCKET PRO-
PELLANT

Solid rocket propellants may be divided into three categories: double-base smokeless propellants, composite propellants, and cast perchlorate propellants. The first two are discussed under individual entries. Examples of United States cast perchlorate propellants are listed below:

AT-161 (Asphalt Base Perchlorate)
Potassium Perchlorate----- 76.5%
Fuel----- 23.5%

AN-507 (Resin Base Perchlorate)
Ammonium Perchlorate----- 75%
Fuel----- 24.825% (50% A-10 polyester resin,
50% styrene)
Additives----- 0.175%

Thiokol (Rubber Base Perchlorate)
Ammonium Perchlorate----- 21.15%
Potassium Perchlorate----- 47.12%
Polysulfide Rubber (Thiokol)----- 28.85%
Additives----- 2.88%

Characteristics:

Solid rocket propellants have a wide range of characteristics, depending upon the individual compositions. While the ideal rocket propellant has not yet been developed, its characteristics have been established as follows:

- a. Uniform ignition and burning
- b. Well-defined, reproducible, and approximately constant burning surface
- c. Reproducible composition with a constant heat of explosion
- d. Nonhygroscopicity
- e. procurable in grains having widely varying burning times, either by changes in composition or structure
- f. Adequate mechanical properties
- g. High performance
- h. Smokelessness
- i. Stability
- j. Not affected by temperature variations

Manufacture:

The manufacture of double-base and composite propellants is discussed under individual entries. Perchlorate propellants in general are the easiest of all solid propellants to manufacture. The oxidizer, pulverized into an extremely fine powder, is added to the fuel, which has been previously melted. The mixture is stirred, cast, and allowed to cool.

SOLID ROCKET PROPELLANT

Uses:

It is apparent from their name that solid rocket propellants are used for rockets and missiles.

Comments:

Solid rocket propellants are coming into increasing usage because of their major advantages over liquid propellants, i.e., their generally good storage characteristics and their ease of handling. However, difficulties in obtaining required characteristics such as uniform burning time has limited the full utilization of their advantages.

SOLVENTLESS PROPELLANT OR
POWDER

See DOUBLE-BASE SMOKELESS
PROPELLANT

STARCH NITRATE

See NITROSTARCH

Straight Dynamite

See also DYNAMITE, MILITARY DYNAMITE,
NITROGLYCERIN

Alternate Nomenclature:

Dynamite No. 1

See Composition below

Foreign Nomenclature:

See DYNAMITE.

Composition:

Straight dynamites can be subdivided into "dynamites with inactive base (Guhr dynamites)" and "dynamites with active base (Extra dynamites)." Representative compositions are given below:

Inactive Base

Nitroglycerin----- 75% } Rarely, the composition may include
Kieselguhr----- 25% } some nitrocellulose.

Active Base (U.S.)

Nitroglycerin----- 40% } May also be made
Sodium Nitrate----- 44 to 45% approx } with ammonium
Wood Charcoal----- 12 to 15% approx } nitrate, giving
Calcium Carbonate---- 1 to 3% approx } ammonia dynamites.

STRAIGHT DYNAMITE

Ammonia Dynamite with Active Base (French Ammon dynamite)

Ammonium Nitrate-----	45%
Nitroglycerin-----	40%
Wood or Cereal Meal-----	10%
Sodium Nitrate-----	5%

Low-freezing straight dynamites (see LOW-FREEZING AND NON-FREEZING DYNAMITES) have compositions in which the nitroglycerin is replaced by nitrated mixtures of glycerin and sugar, or of glycerin and sugar (see SUGAR NITRATE).

Characteristics:

Inactive base -- Dynamites with inactive base are reddish-yellow to brownish yellow, and almost white when frozen. They resemble fresh earth in that they are a crumbly-plastic mass. They are nonhygroscopic. Normally they will freeze at 10°C; when frozen they are less sensitive than the plastic material. If made from nitrocellulose which has been fully stabilized, dynamites with inactive base are completely stable, even at tropical temperatures. Their sensitivity to shock and friction is not quite as high as that of nitroglycerin; they are also less brisant than nitroglycerin. However, these dynamites will detonate when hit by a rifle bullet. They are more sensitive than other types of dynamites.

Active base -- Dynamites with active base are greasy powders which are loose and moist. The ammonia dynamites (varieties containing ammonium nitrate) are especially strong but have the disadvantage of high hygroscopicity. Sodium nitrate also lends its characteristics of hygroscopicity to these dynamites. Other characteristics are similar to dynamites with inactive base.

Manufacture:

Straight dynamites are manufactured by mixing nitroglycerin with kieselguhr (in the case of inactive base) or other absorbent material (in the case of active base). The mixing is done by shovel or by hand and the resulting material is screened to insure complete uniformity and fine graining.

Uses:

Since straight dynamites are fast and shattering when detonated, they are used where a "quick" explosive is desired. Such uses include underwater blasting (excluding ammonia dynamites), steel demolition work, and the priming of deep-well blasting gelatins. Dynamites with inactive base are practically non-existent in the United States today; they have been replaced by active base types and are used only as a basis of comparison for other types of dynamites.

STRAIGHT DYNAMITE

Comments:

The terminology for straight dynamites has not met with consistent usage. The term "dynamite" often is used to refer only to dynamites with active and inactive bases (i.e., straight dynamites), whereas it is more properly used to refer to the entire dynamite class of explosives. The term "straight dynamite" has been used in the United States to refer to dynamites with active base; the term is correctly used, however, to include all of the dynamites discussed in this entry. The term "dynamite no. 1" is popularly used in the United States as an alternate name for dynamites with inactive base.

SUCROSE OCTONITRATE

See SUGAR NITRATE

SUGAR NITRATE

Alternate Nomenclature: Nitrosugar

Composition:

The following sugar nitrates have been found to exhibit explosives characteristics:

Arabinose Tetranitrate (Nitroarabinose) -- $C_5H_6O(ONO_2)_4$ or
 $C_5H_6N_4O_13$
Glucose Pentanitrate (Nitroglucose) ----- $C_6H_7O(ONO_2)_5$ or
 $C_6H_7N_5O_16$
Lactose Hexanitrate ----- $C_{12}H_{16}O_5(ONO_2)_6$ or
 $C_{12}H_{16}N_6O_{23}$
Lactose Octonitrate (Nitrolactose) ----- $C_{12}H_{14}O_3(ONO_2)_8$ or
 $C_{12}H_{14}N_8O_{27}$
Maltose Octonitrate (Nitromaltose) ----- $C_{12}H_{14}O_3(ONO_2)_8$ or
 $C_{12}H_{14}N_8O_{27}$
Mannose Pentalnitrate (Nitromannose) ----- $C_6H_7O(ONO_2)_5$ or
 $C_6H_7N_5O_16$
Sucrose Octonitrate (Nitrosucrose) ----- $C_{12}H_{14}O_3(ONO_2)_8$ or
 $C_{12}H_{14}N_8O_{27}$

Many other sugar nitrates have been prepared, but they have no importance as explosives.

SUGAR NITRATES

Characteristics:

Sugar nitrates appear as colorless or white crystals. They melt at comparatively low temperatures, ranging from 80° to 165°C. In a molten state, they are sticky and resinous; upon cooling, they do not crystallize easily or rapidly. In this, they resemble the sugars from which they are produced. Sugar nitrates are inherently unstable. Compounds made from them are far less stable than nitroglycerin unless a stabilizer (normally diphenylamine) is added.

Manufacture:

Sugar of the required type is dissolved in concentrated nitric acid. Concentrated sulfuric acid is added drop by drop, and the sugar nitrate will crystallize out of solution.

Uses:

Sugar nitrates are utilized in explosives as substitutes for nitroglycerin. Sucrose octonitrate has been used in the United States in mixtures with nitroglycerin for the manufacture of "nitrohydrene" (82-86% nitroglycerin, 14-18% sucrose octonitrate), which has functioned as a non-freezing dynamite. Mixtures of glucose pentanitrate and nitroglycerin, and lactose octonitrate and nitroglycerin have also been prepared. These mixtures are similar to nitroglycerin in explosive strength, but are difficult to stabilize.

Comments:

Since sugar nitrates are used in explosives only as substitutes for nitroglycerin, the extent of their use depends entirely upon the degree of scarcity of glycerin and their cost of production. At best, a sugar nitrate will replace only 14 to 18% of nitroglycerin in an explosive compound; the increased need for nitric acid to manufacture sugar nitrates makes their use a saving of dubious value.

SYM-TRINITROTOLUENE

See TRINITROTOLUENE

T-9

See COMPOSITION T-9

TEGN

TEGN

Alternate Nomenclature:
Triethyleneglycoldinitrato

Composition:

$C_6H_{12}N_2O_8$ -- chemical compound containing the following percentages by weight of the elements: Carbon----- 29.9%
Hydrogen----- 5.4%
Nitrogen----- 11.7%
Oxygen----- 53.0%

Characteristics:

TEGN is a liquid compound with a melting point of -19°C. It will explode when subjected to a temperature of 223°C for five seconds. It is less sensitive to impact than TNT, and is unaffected by friction tests. It is, however, volatile.

Manufacture:

Purified triethyleneglycol is nitrated (at a temperature of $0^\circ \pm 5^\circ C$), and then poured over water and extracted three times with ether. The extract is washed first with water and then with a sodium bicarbonate solution. The product is dried by removing water and ether.

Uses:

TEGN has been used as an ingredient of rocket and double-base propellants, especially by the Germans during World War II.

Comments:

The quantity production of TEGN still presents some difficulties and its use in propellant compositions is being replaced by other liquid nitrates.

TETRACENE

Alternate Nomenclature: Foreign Nomenclature:
4-guanyl-(nitrosoaminoguanyl) Soviet: Tetratsin
1-tetrazene

Composition:

$H_2N.C(=NH).NH.NH.N=N.C(=NH).NH.NH.NO$ or $C_2H_8N_4O$ -- chemical compound containing the following percentages by weight of the elements: Carbon----- 12.77%
Hydrogen----- 4.28%
Nitrogen----- 74.44%
Oxygen----- 8.51%

Characteristics:

Tetracene is a colorless or pale yellow, fluffy, press-loaded material which melts with explosive violence at from 115° to 160°C. It will explode when subjected to a temperature of 160°C for five seconds. Tetracene is slightly hygroscopic. While it is stable at temperatures of 75°C and under, it will decompose at higher temperatures, the decomposition rate increasing rapidly as the temperature increases. Tetracene is somewhat more sensitive than mercuric fulminate. It detonates readily from exposure to flame. Its explosion temperature is relatively low and makes it useful in priming compositions.

Manufacture:

Tetracene may be prepared by dissolving aminoguanidine carbonate in a mixture of glacial acetic acid (pure acid) and water. After the solution has been filtered and cooled, solid sodium nitrite is added. The tetracene precipitates, and is collected and washed.

Uses:

Tetracene is used either as an ingredient of priming compositions or as an intermediate booster. It is not used to initiate the detonation of high explosives since it will not detonate TNT, and will detonate PETN and tetryl only if the tetracene is unpressed.

TETRALITE

See TETRYL

TETRANITROANILINE

See also AROMATIC NITRO COMPOUNDS

Alternate Nomenclature:

TNA

Composition:

$C_6H(NH_2)(NO_2)_4$ or $C_6H_3N_5O_8$ -- chemical compound containing the following percentages by weight of the elements:

Carbon----- 26.38%

Hydrogen---- 1.11%

Nitrogen---- 25.64%

Oxygen----- 46.87%

TETRANITROANILINE

Characteristics:

Tetranitroaniline is a greenish yellow to olive green crystalline material which melts at from 210° to 215°C with decomposition. It does not react with metals. Tetranitroaniline is nonhygroscopic, and completely stable in dry storage. However, long-term exposure to moisture tends to promote hydrolysis of the compound. Tetranitroaniline is more sensitive to impact and friction than TNT. It is readily detonated by the penetration of a rifle bullet. It is one of the strongest high explosives, being about 40% stronger than TNT.

Manufacture:

Benzene, reacted with mixed acid, is nitrated to dinitrobenzene, which is converted to metanitroaniline by treatment with a sodium sulfide solution. Metanitroaniline is converted to metanitroaniline sulfate by being reacted with sulfuric acid. The sulfate, in turn, is nitrated to tetranitroaniline by reacting it with strong mixed acid.

Uses:

Tetranitroaniline has been used as an ingredient of cheap, relatively insensitive blasting explosives, so as to increase both explosive strength and sensitivity to detonation. It has also been used as a partial substitute for mercuric fulminate in commercial blasting caps or electric detonators, and, by the Soviet Union, as a booster charge in ammunition. It is not used as a military bursting charge.

Comments:

Tetranitroaniline is considerably more expensive to produce than is TNT. For this reason, and because of its high sensitivity, it is not suitable as a military bursting charge. Although the addition of as little as 5% paraffin or 25% dinitrobenzene would reduce the sensitivity of tetranitroaniline to manageable proportions, such additions would reduce the compound's explosive strength to a point making impracticable its use as a military high explosive. Tetranitroaniline is not to be confused with trinitroaniline, which is a different chemical compound.

TETRANITROERYTHRITOL

See PETN

TETRANITROMETHYLANILINE

See TETRYL

TETRANITROTETRAZACYCLE-OCTANE

TETRANITROTETRAZACYCLE-OCTANE See HMX

TETRYL

See also AROMATIC NITRO COMPOUNDS

Alternate Nomenclature:

Pyronite
Tetralite
Trinitrophenylmethyl-nitramine
(Formerly also Tetranitromethylaniline)

Foreign Nomenclature:

British: CE (Composition, exploding)
French: Tetryl
German: Tetryl
Italian: Tetrile, Tetryl
Japanese: Meiayaku
Russian: Tetril
Spanish: Tetrannitrometil-anilina, Tetryl

Composition:

$C_6H_2(NO_2)_3(NCH_3NO_2)$ or $C_7H_5N_5O_8$ -- chemical compound containing the following percentages by weight of the elements:

Carbon----- 29.28%
Hydrogen---- 1.75%
Nitrogen---- 24.39%
Oxygen----- 44.58%

Characteristics:

Tetryl is a colorless or yellow, crystalline, press-loaded material which melts at between 129° and 130°C. It will ignite when subjected to a temperature of 257°C for five seconds. Tetryl does not react with metals. It is only slightly hygroscopic, but the presence of even a slight amount of moisture will reduce its effectiveness. Tetryl is more sensitive to shock and friction than TNT. It is easily detonated by penetration of a rifle bullet. It is completely stable at temperatures of 120°C and under.

Manufacture:

Benzene is treated with mixed acid, and the resulting nitrobenzene is reduced to aniline by treatment with iron filings and hydrochloric acid. The aniline is combined with methyl alcohol (wood alcohol) by heating under pressure in the presence of sulfuric acid or iodine. The resulting dimethylaniline is dissolved in sulfuric acid and the solution is treated with mixed acid. The tetryl precipitates, and is boiled, ground, re-boiled, and dried.

TETRYL

Uses:

Tetryl is universally used as a booster, rarely as a bursting charge, and in the manufacture of tetrytol (see entry). It is also used less extensively in military and commercial detonators, as a partial substitute for mercuric fulminate charges by being pressed into the bottom of the detonator shell and covered with a small priming charge of fulminate.

TETRYTOL

Alternate Nomenclature:
None

Foreign Nomenclature:
Russian: Tetritol

Composition:

Tetrytol is a composition containing varying proportions of tetryl and TNT. The following compositions are typical:

Tetryl-----	80%	75%	70%	65%
TNT-----	20%	25%	30%	35%

Characteristics:

Tetrytol is a light yellow to buff, cast-loaded, solid which melts at 68°C. The compositions listed above will ignite when subjected to the following temperatures for five seconds: 80/20 tetrytol--290°C; 75/25 tetrytol--310°C; 70/30 tetrytol--320°C; and 65/35 tetrytol--325°C. Dry tetrytol will slightly affect magnesium-aluminum alloy. Wet tetrytol will affect copper, brass, aluminum, magnesium, magnesium-aluminum alloy, mild steel, and mild steel plated with cadmium, copper, zinc, or nickel. Tetrytol is practically nonhygroscopic in that it absorbs only 0.02% moisture when exposed to an atmosphere of 90% relative humidity at 30°C. Its sensitivity to impact, shock, heat, and initiation is intermediate between that of TNT and that of tetryl. It is more brisant than TNT and less brisant than tetryl. It is entirely stable in storage at 65°C and under. Higher temperatures, however, cause some exudation and distortion of shape.

Manufacture:

TNT is heated until it has melted and its temperature is slightly above 100°C. Tetryl is added and the temperature is decreased until the proper viscosity for pouring is obtained. Part of the tetryl dissolves in the TNT; the remainder forms a simple mixture with the molten TNT.

Uses:

Tetrytol is used as a demolition explosive, a bursting charge for mines, and in the bursting tubes of chemical shells.

TNA

TNA

See TETRANITROANILINE

TNP

See PICRIC ACID

TNPH

See also AROMATIC NITRO COMPOUNDS

Alternate Nomenclature:

Ethyl Picrate
Trinitrophenetole
Trinitrophenylethylether

Composition:

$C_6H_2(NO_2)_3C_2H_5$ or $C_8H_7N_3O_6$ -- chemical compound containing the following percentages by weight of the elements:

Carbon----- 39.81%
Hydrogen---- 2.92%
Nitrogen---- 17.43%
Oxygen----- 39.81%

Characteristics:

TNPH is a cast-loaded explosive material with a melting point of 78.3°C . It is similar to TNT in power and can be successfully mixed with cyclorite and ammonium nitrate for other explosives. However, it is more sensitive to handle than TNT, and is more complicated and expensive than TNT to manufacture.

Uses:

TNPH normally is used as a component in booster and bursting charge compositions. It has been proposed, however, as a bursting charge in French ammunition where serious toluene shortages have required the development of TNT substitutes.

Comments:

TNPH is of value as a high explosive only in cases where TNT substitutes are required. In other cases, its manufacturing and sensitivity disadvantages outweigh its usefulness except as an ingredient in explosive compositions.

TNT

TNT

See TRINITROTOLUENE

TOLITE

See TRINITROTOLUENE

TORPEX

Alternate Nomenclature:
Tpx

Foreign Nomenclature:
Swedish: Hexotonal (Brand name
used by Before of
Sweden)

Composition:

Cyclonite-----	41%
TNT-----	41%
Aluminum-----	18%

Slight variations in the percentage of ingredients has resulted in the following types:

	Torpex I	Torpex II	Torpex/Wax
Cyclonite-----	45%	42%	41%
TNT-----	37%	40%	37%
Aluminum-----	18%	18%	18%
Beeswax-----	...	...	1%

Characteristics:

Torpex is a silvery-white, cast-loaded explosive material. It will detonate when subjected to a temperature of 260°C for five seconds. It reacts slightly with brass. Torpex is nonhygroscopic when exposed to an atmosphere of 90% relative humidity at 30°C. It is more sensitive to impact than composition B, and is readily detonated by the penetration of a rifle bullet. It is more brisant than TAT, but less brisant than cyclonite. Torpex has a high order of stability; it has been stored for 13 months at 65°C without change. However, slight traces of moisture in the composition will result in the liberation of gases which may rupture the ammunition component it fills and which will increase the sensitivity of the torpex to shock.

Manufacture:

TNT is heated until it has melted and its temperature is

TORPEX

about 100°C. Slightly wet cyclonite is added slowly, and mixing and heating are continued until all moisture has been removed. Grained aluminum is added and stirring is continued until a uniform mixture results. The temperature of the mixture is decreased until the proper viscosity for pouring is obtained.

Uses:

Torpex is used by the United States and Great Britain as a bursting charge in mines, torpedoes, and depth charges; it was used by Germany as a bursting charge in bombs.

Comments:

Because of the sensitivity of torpex, two other explosives have been developed, DBX (see entry) and HBX-1. HBX-1 has a torpex composition plus a desensitizer and calcium chloride (it is actually made from composition B, composition D-2, INT, and aluminum). It is less sensitive and less brisant than torpex, and is nonhygroscopic. HBX-1 has not been standardized for general use.

TPX

See TORPEX

TRIAZIDOTRINITROBENZENE

Alternate Nomenclature:

Trinitrotriazidobenzene

Composition:

Chemical compound containing the following percentages by weight of the elements: Carbon----- 21.4%
Nitrogen---- 50.0%
Oxygen----- 28.6%

Characteristics:

Triazidotrinitrobenzene is a greenish yellow, press-loaded explosive, melting at 131°C. It is nonhygroscopic, and will not exude. It does not react with more common metals such as iron, steel, copper, and brass.

~~TRIAMINOTRINITROBENZENE~~

Manufacture:

Sym-trichlorobenzene is prepared by chlorinating aniline to form trichloroaniline, and eliminating the amino group. The sym-trichlorobenzene is nitrated, and the precipitated trinitro trichlorobenzene (either powder or in acetone solution) is added to a solution of sodium azide in alcohol and is stirred rapidly. Trinitrotriazidobenzene precipitates and is washed and dried.

Uses:

Triazidotrinitrobenzene has recently been found to be very suitable for use in priming compositions.

TRIDITE

Alternate Nomenclature:

None

Foreign Nomenclature:

British:	Nellite
French:	DD
Italian:	MBT

Composition:

The following composition may be taken as representative:

Picric Acid----- 80%
Dinitrophenol---- 20%

Characteristics:

Tridite is a cast-leaded explosive. It is slightly inferior to picric acid as an explosive, but has the advantage of being castable. It will not exude.

Uses:

Tridite has been used as a bursting charge for artillery shells and bombs. However, with the modern trend away from using picric acid in bursting charges, tridite is used with decreasing frequency.

TRIETHYLENEGLYCOLDINITRATE

See TEGN

TRILITE

TRILITE

See TRINITROTOLUENE

TRIMETHYLNITRINITRAMINE

See CYCLONITE

TRIMONITE

Alternate Nomenclature:
None

Foreign Nomenclature:
French: M Mn

Composition:

Picric Acid----- 88%
Mononitronaphthalene---- 12%

During World War II, France used the following modified composition:

Picric Acid----- 70%
Mononitronaphthalene---- 30%

Characteristics:

Trimonite is a cast-loaded explosive melting at 90°C. It will detonate when subjected to a temperature of 315°C for five seconds. It is less sensitive to initiation and less brisant than straight picric acid. However, when stored at elevated temperatures, it will exude.

Manufacture:

Picric acid and mononitronaphthalene are melted together and stirred until the composition is uniform.

Uses:

Trimonite has been used as a bursting charge for artillery shells and bombs, especially in France. However, with the modern trend away from using picric acid in bursting charges, trimonite is used with decreasing frequency.

TRINITROPHENETOLE

See TNPH

TRINITROPHENOL

TRINITROPHENOL

See PICRIC ACID

TRINITROPHENYLETHYLETHER

See TNTV

TRINITROPHENYLMETHYLNITRAMINE

See TETRYL

TRINITROTOLUENE

See AROMATIC NITRO COMPOUNDS

Alternate Nomenclature:

Coal Tar Salt

Sym-Trinitrotoluene (Sym-metrical Trinitrotoluene)

TNT

Tolite

Trilite

Trinitrotoluol

Triton

Trotyl

NOTE: The terms "trotyl" and "tolite" are of British and French origins respectively.

Foreign Nomenclature:

British: Trotyl

French: Tolite, trinitrotoluène, trinitrotoluol, trotyl

German: Fp-02, füllpulver 1902, tolit, trinitrotoluol, trotyl

Hungarian: Trilit, trinitrotoluol, tritolo, trotil

Italian: Tolite, trinitrotoluene, trinitrotoluolo, tritolo

Japanese: Chakatusuyaku, type 92 (see also separate entry)

Russian: T, tol, trotil

Spanish: Tolita, trilita, trinitrotolueno, trinitrotoluol

Composition:

$C_6H_2CH_3(NO_2)_3$ or $C_6H_5N_3O_6$ -- chemical compound containing the following percentages by weight of the elements:

Carbon----- 37.01%

Hydrogen----- 2.22%

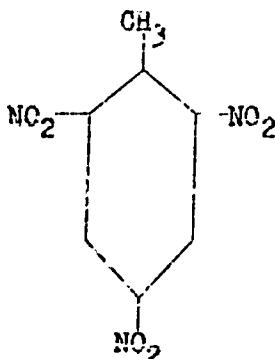
Nitrogen----- 18.50%

Oxygen----- 42.27%

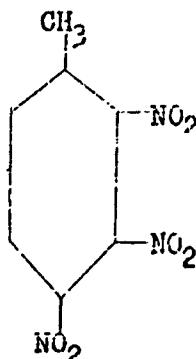
TRINITROTOLUENE

TNT occurs in six isomers, designated alpha-, beta-, gamma-, delta-, epsilon-, and zeta-trinitrotoluene. The empirical formula given above applies to all six varieties; differences among the isomers are due to the different locations of one of the nitro groups in the compound's structure. For example, alpha-, beta-, and gamma-trinitrotoluene have the following structural formulae:

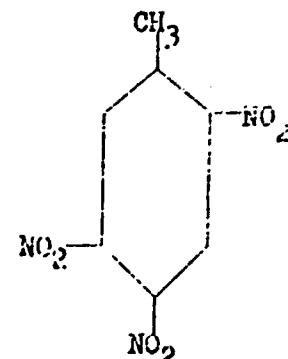
α -TNT



β -TNT



γ -TNT



Characteristics:

Trinitrotoluene appears as light yellow flakes or rhombohedral crystals. TNT is classified into three grades in accordance with military specifications: Grade I with a solidification point of at least 80°C; Grade II with a solidification point of at least 79.5°C; and Grade III with a solidification point of at least 76°C. Trinitrotoluene may be cast- or press-loaded; cast-loading is the preferred method. In liquid form, trinitrotoluene is much more sensitive to impact than the solid material. It is practically nonhygroscopic, absorbing not more than 0.2% moisture. It is one of the least sensitive of the military high explosives. Its brisance is equal to that of picric acid and guncotton, less than that of tetryl, EDNA, PETN, cyclonite, and nitroglycerin. It is quite stable in closed storage, although in the presence of certain chemical compounds such as alkalies and ammonia it forms unstable and dangerous compounds. Moreover, exposure to sunlight or ultraviolet light in the presence of oxygen causes progressive discoloration and decomposition and increasing sensitivity to impact.

Alpha-trinitrotoluene (symmetrical TNT or simply sym-TNT) constitutes 98% or more of the commercial product and the characteristics of this isomer govern the characteristics of the product. Grade I TNT, which is the purest of the three grades, contains the least amounts of impurities in the form of isomers other than alpha-trinitrotoluene.

TRINITROTOLUENE

Manufacture:

Trinitrotoluene may be manufactured by one-, two-, or three-stage nitration processes, or more recently, by the continuous process, with toluene and mixed acid as the raw materials. While all four processes have been used on a production basis, the three-stage process has had the advantages of maximum yield, greater purity of product, and greater ease of control of acid concentration and temperature conditions. The continuous process, as employed by the Bofors Company of Sweden, is coming into wide usage as its advantage of continuous TNT yield becomes increasingly apparent.

In the one-stage process, a large excess of strong mixed acid is used and the temperature is gradually raised. TNT can be produced in the one process without transfer or separation of spent acid from intermediate products. In the two-stage process, either mono- or dinitrotoluene is produced in the first stage, and TNT in the second. In the three-stage process, by the use of three different acid mixtures and different conditions of temperature, etc., there are successively produced mono-, di-, and trinitrotoluene, each stage being carried out in a different nitrator. However, it should not be assumed that at any stage there is only one nitrated product. Thus all of the toluene is not nitrated to mononitrotoluene before any mononitrotoluene is nitrated to dinitrotoluene; all of the mononitrotoluene is not nitrated to dinitrotoluene before any dinitrotoluene is nitrated to trinitrotoluene. The continuous process employs the same raw materials as the other processes, but operates on a continuous basis rather than on the "batch" basis of the other processes. Hence, it offers a greater yield over a given time period than do any of the other processes.

The TNT resulting from any of the processes must be washed, purified by remelting, granulated, screened, and dried. Grades I and II TNT must be prepared by recrystallization or special chemical treatment of Grade III TNT. Grade I TNT requires additional purification and is the most expensive of the three grades.

"TNT-oil," the material used in some dynamites, is a by-product in the process of TNT purification. Crude TNT is treated with organic solvents (such as alcohol or carbon tetrachloride) to remove any beta- and gamma-TNT present. Upon distillation, the organic solvents are recovered, and the residue is TNT-oil.

TRINITROTOLUENE

Uses:

TNT is universally used as the bursting charge for high explosive artillery shells, mines, bombs, and grenades. It may be used alone or mixed with ammonium nitrate (see AMAROL). It has also been used to a limited extent for demolition and blasting and in industrial explosives. It is used also in the Bickford fuse. TNT is also now being used as a constituent in some solid rocket propellants.

For uses of mononitrotoluene and dinitrotoluene, see Appendices.

TRINITROAZIDOBENZENE

See TRIAZIDOTRINITROBENZENE

TRIPLE-BASE SMOKELESS PROPELLANT See also SMOKELESS PROPELLANT

Alternate Nomenclature:

See Comments below

Composition:

Triple-base smokeless propellants contain three principal explosive ingredients or "bases": nitrocellulose, nitroglycerin, and nitroguanidine. The following compositions are representative of United States propellants in this category:

	M15	M17
Nitrocellulose-----	20.0%	20.0%
Nitroglycerin-----	19.0%	21.5%) To which is
Nitroguanidine-----	54.7%	54.7%) added 0.1%
Ethyl Centralite-----	6.0%	1.5%) graphite.
Cryolite-----	0.3%	0.3%)
Unknown-----	...	2.0%)

Comments:

Triple-base propellants are often classified as a type of double-base propellant since they share many of the same characteristics. There are, however, sufficient differences to justify their separate classification. Due to the nitroguanidine content, triple-base propellants burn at temperatures lower than other propellants and consequently cause far less gun barrel erosion than other propellants. Moreover, they are more stable than other propellants since nitroguanidine acts as a stabilizer to a certain extent. The burning of triple-base propellants yields higher gas volume values than equal quantities of other propellants and thus imparts higher velocities to projectiles.

TRITON

TRITON

See TRINITROTOLUENE

TRITONAL

Alternate Nomenclature:
None

Composition:

TNT----- 80%
Aluminum--- 20%

Characteristics:

Tritonal is a silvery gray, cast-loaded material. It will explode when subjected to a temperature of 470°C after five seconds. It is very similar in its characteristics to TNT. It is essentially nonhygroscopic. It is slightly more sensitive to impact than TNT, but is equal to TNT in sensitivity to initiation. Its brisance is less than that of TNT, but it is more powerful than TNT.

Manufacture:

TNT and aluminum are fed separately into a steam-heated kettle, where the mixture is agitated and heated until all of the TNT has melted. The resulting tritonal is ready for cast-loading.

Uses:

Tritonal is a standard United States military high explosive used in bombs for its high blast effect.

TROJAN EXPLOSIVE

See also NITROSTARCH

Alternate Nomenclature:
None

Composition:

Trojan explosives have been made in two types depending upon usage: Trojan grenade explosives and Trojan trench mortar shell explosives. The compositions are almost identical. The composition listed below gives the input limits for each ingredient:

TROJAN EXPLOSIVE

	Not less than	Not more than
Nitrostarch-----	23.0%	27.0%
Ammonium Nitrate-----	31.0%	35.0%
Sodium Nitrate-----	35.0%	40.0%
Charcoal-----	1.5%	2.5%
Heavy hydrocarbons-----	0.5%	1.5%
Antacid-----	0.5%	1.5%
Diphenylamine-----	0.2%	0.4%
Moisture-----	...	1.2%

Characteristics:

Trojan explosives are grayish black in color and have a consistency similar to brown sugar. They are very hygroscopic, although oil in the compounds tends to reduce this disadvantage. Exposure to moisture tends to reduce both strength and sensitivity. These explosives are much less sensitive than straight nitrostarch, and are particularly insensitive to ignition and sympathetic detonation.

Manufacture:

All materials other than the straight nitrostarch are ground and dried. The nitrostarch is mixed with this material.

Uses:

Trojan explosives have been used as bursting charges for hand grenades, rifle grenades, and trench mortar shells. They are only used very rarely at present.

TROTYL

See TRINITROTOLUENE

TYPE 1

Alternate Nomenclature: Foreign Nomenclature:

The entry is given in the English equivalent of the Japanese nomenclature; there is no corresponding U.S. explosive.

None

Composition:

Ammonium Picrate-----	81%
Aluminum Powder-----	16%
Wood Pulp-----	2%
Petroleum-----	1%

TYPE 1

Comments:

Type 1 is a Japanese explosive composition which was used during World War II as a bursting charge in depth charges.

TYPE 88

Alternate Nomenclature:

The entry is given in the English equivalent of an alternate Japanese nomenclature; there is no corresponding U.S. explosive.

Foreign Nomenclature:

Japanese: Haensosanbakuyak

Composition:

Ammonium Perchlorate-----	75%
Ferro-Silicon-----	16%
Wood Meal-----	6%
Crude Petroleum-----	3%

Characteristics:

Type 88 is a gray, press-loaded explosive composition. It will react with metals. Although it is stronger than TNT, it lacks the shattering power of TNT. It is hygroscopic and unstable.

Uses:

Type 88 is a Japanese explosive composition which can be used as a relatively cheap underwater explosive.

TYPE 92

Alternate Nomenclature:

The entry is given in the English equivalent of the Japanese nomenclature; see Comments below.

Foreign Nomenclature:

None

Composition:

TNT-----	66%
Aluminum Powder-----	34%

Comments:

Type 92 is a Japanese explosive composition which was used

TYPE 92

during World War II as a bursting charge for machinegun bullets. The United States has a similar explosive in tritonal (see entry). The term "type 92" has often been applied by the Japanese to refer to straight TNT.

NOTE: Japan incorporated high explosive fillers into machinegun bullets with calibers as small as 7.7-mm.

TYPE 94

Alternate Nomenclature: Foreign Nomenclature:

The entry is given in the None
English equivalent of the
Japanese nomenclature;
there is no corresponding
U.S. explosive.

Composition:

Trinitroanisol----- 60%
Cyclonite----- 40%

Comments:

Type 94 is a Japanese explosive composition which was used during World War II as a bursting charge in torpedoes.

Type 97

Alternate Nomenclature: Foreign Nomenclature:

The entry is given in the Japanese: Seigetta
English equivalent of an
alternate Japanese nomen-
clature; there is no
corresponding U.S.
explosive.

Composition:

TNT----- 60%
Hexanitrodiphenylamine----- 40%

Comments:

Type 97 is a Japanese explosive composition which was used during World War II as a bursting charge in torpedoes and depth charges.

TYPE 98

TYPE 98

Alternate Nomenclature: Foreign Nomenclature:
The entry is given in the Japanese: H2Kongo
English equivalent of an alternate Japanese nomenclature; there is no corresponding U.S. explosive.

Composition:

Trinitroanisole----- 70% or 60%
Hexanitrodiphenylamine---- 30% or 40%

Comments:

Type 98 is a Japanese explosive composition which was used during World War II as a priming and booster charge.

III FOREIGN SECTION

BRITISH TERMS

<u>British Nomenclature</u>	<u>Reference in General Section</u>
Amatol	Amatol
Astralite	Astralite
CE	Tetryl
Cordite	Cordite
Gelignite	Gelatin Dynamite
Lyddite	Picric Acid
N.C.T.	Single-Base Smokeless Propellant
Nellite	Tridite
Nitrocellulose, Tubular	Single-Base Smokeless Propellant
Permitted Explosive	Permissible Explosive
Picrite	Nitroguanidine
RDX	Cyclonite
Research Department Explosive	Cyclonite
Trotyl	Trinitrotoluene
Tubular Nitrocellulose	Single-Base Smokeless Propellant

FRENCH TERMS

<u>French Nomenclature</u>	<u>Reference in General Section</u>
Acide Picrique	Picric Acid
Amatol	Amatol
Ammonal	Ammonal
Armonite	Ammonite
Astralit	Astralite
Azoture d'argent	Silver Azide
Azcture de plomb	Lead Azide
Balistite	Ballistite
Cheddite	Cheddite
Cordite	Cordite
Coton-collodion	Guncotton
Coton-nitré	Guncotton
Coton-poudre	Guncotton
DD	Tridite
Dynamite	Dynamite
Ecrasite	Erasite
Exogène	Cyclonite
Explosif à la nitroglycérine	Nitroglycerin
Explosif antigrisouteux	Permissible Explosive
Explosif de sûreté	Permissible Explosive
Fulnicoton	Guncotton
Fulminate de mercure	Mercuric Fulminate

FRENCH TERMS (cont'd)

<u>French Nomenclature</u>	<u>Reference in General Section</u>
Gélatine détonante	Blasting Gelatin
Gélatine-dynamito	Gelatin Dynamite
Gélatine explosive	Blasting Gelatin
Huile de Nobel	Nitroglycerin
Huile explosive	Nitroglycerin
M Mn	Trimorite
Mélinite	Picric Acid
Nitrat d'ammoniaque	Ammonium Nitrate
Nitrogélatine	Gelatin Dynamite
Nitroglycérine	Nitroglycerin
Nitrure d'argent	Silver Azide
Nitrure de plomb	Lead Azide
Picrate d'ammoniaque	Explosive D
Poudre à base de nitroglycérine	Nitroglycerin
Poudre à la nitroglycérine	Nitroglycerin
Poudre noire	Black Powder
Pyroxylol	Nitrocellulose
Tetryl	Tetryl
Tolite	Trinitrotoluene
Trinitrophénol	Picric Acid
Trinitroresorcinate de plomb	Lead Styphnate
Trinitrotoluène	Trinitrotoluene
Trinitrotoluol	Trinitrotoluene
Trotyl	Trinitrotoluene
Xyloïdine	Nitrostarch

GERMAN TERMS

<u>German Nomenclature</u>	<u>Reference in General Section</u>
Amatol	Amatol
Ammonal	Ammonal
Ammonit	Ammonite
Ammoniumnitrat	Ammonium Nitrate
Ammoniumpikrat	Explosive D
Ammoniumsalpeter	Ammonium Nitrate
Ammonpulver	Ammonal
Astralit	Astralite
Ballistit	Ballistite
Bittersäure	Picric Acid
Bleiazid	Lead Azide
Bleitrinitroresorzinat	Lead Styphnate
Cheddit	Cheddite
Cordite (rare)	Cordite
Donarit	Donarite
Dynamit	Dynamite
Ekrasit	Ecrasite
Fp-02	Trinitrotoluene
Fp-88	Picric Acid
Füllpulver 1888	Picric Acid
Füllpulver 1902	Trinitrotoluene
Gelatine-dynamit	Gelatin Dynamite
Glynoin	Nitroglycerin
Guhr-dynamit	Dynamite with Inactive Base (Guhr Dynamite)

GERMAN TERMS (Cont'd)

<u>German Nomenclature</u>	<u>Reference in General Section</u>
Hexogen	Cyclonite
Knallquecksilber	Mercuric Fulminate
Kolloidiumwolle	Guncotton
Kordit	Cordite
Melinit	Picric Acid
Nitrogelatine	Gelatin Dynamite
Nitroglyzerin	Nitroglycerin
Nitroglyzerinpulver	Nitroglycerin
Nitroglyzerinsprengstoff	Nitroglycerin
Nitropentaerythrit	PETN
Nitrozellulose	Nitrocellulose
Nitrozellulosepulver	Guncotton
Pentrit	PETN
Pikrinsäure	Picric Acid
Schiesashanmwolle	Guncotton
Schiesswolle	Guncotton
Schlagwettersichere Sprengstoff	Permissible Explosive
Schwarzpulver	Black Powder
Sicherheitsdynamit	Permissible Explosive (Safety Dynamite)
Silberazid	Silver Azide
Sprenggelatine	Blasting Gelatin
Sprenggummi	Blasting Gelatin
Sprengöl	Nitroglycerin
Sprengstoff	Dynamite

GERMAN TERMS (Cont'd)

<u>German Nomenclature</u>	<u>Reference in General Section</u>
Tetryl	Tetryl
Tolit	Trinitrotoluene
Trinitrophenol	Picric Acid
Trinitrotoluol	Trinitrotoluene
Trotyl	Trinitrotoluene
Wetterdynamit	Permissible Explosive
WPC/89	Ballistite
Wurfelpulver/89	Ballistite
Xyloidin	Nitrostarch

HUNGARIAN TERMS

<u>Hungarian Nomenclature</u>	<u>Reference in General Section</u>
Amoniák robbanó-anyag	Ammonal
Ammoniumnitrát	Ammonium Nitrate
Ammonsalétron	Ammonium Nitrate
Ballisztit	Ballistite
Cheddít	Cheddite
Dinamit	Dynamite
Fekete löpor	Black Powder
Kottós alapanyagú löpor	Double-Base Smokeless Propellant
Kordit	Cordite
Robbanó-zselatin	Blasting Gelatin
Trilit	Trinitrotoluene
Trinitrotoluol	Trinitrotoluene
Tritolo	Trinitrotoluene
Trotill	Trinitrotoluene

ITALIAN TERMS

<u>Italian Nomenclature</u>	<u>Reference in General Section</u>
Acido d'argento	Silver Azide
Acido di piombo	Lead Azide
Acido picrico	Picric Acid
Alto esplosivo al clorato di potassio	Cheddite
Amatolo	Amatol
Ammonal	Ammonal
Ammonite	Ammonite
Astralite	Astralite
Azoimide d'argento	Silver Azide
Azoimide di piombo	Lead Azide
Balistite	Ballistite
Cheddite	Cheddite
Cordite	Cordite
Cotone fulminante	Guncotton
Dinamito	Dynamite
Ecrasite	Ecrasite
Esplosivo alla nitroglicerina	Nitroglycerin
Esplosivo ammissibile	Permissible Explosive
Esplosivo di sicurezza	Permissible Explosive
Fulminato di mercurio	Mercuric Fulminate
Fulmicotone	Guncotton
Gelatina-dinamite	Gelatin Dynamite

ITALIAN TERMS (Cont'd)

<u>Italian Nomenclature</u>	<u>Reference in General Section</u>
Gelatina esplosiva	Blasting Gelatin
MBT	Tricite
Nitrato ammonico	Ammonium Nitrate
Nitrocellulosa	Nitrocellulose
Nitrogelatina	Gelatin Dynamite
Nitroglycerina	Nitroglycerin
Olio detonante	Nitroglycerin
Olio esplosivo	Nitroglycerin
Pentrite	PETN
Pertite	Picric Acid
Picrato ammonico	Explosive D
Polvere a base di nitrocerina	Nitroglycerin
Polvere nera	Black Powder
Silcidina	Nitrostarch
Stifnato di piombo	Lead Styphnate
T-4	Cyclonite
Tetrile	Tetryl
Tetryl	Tetryl.
Tolite	Trinitrotoluene
Trimetilentrinitroamina	Cyclonite
Trinitrofenolo	Picric Acid
Trinitroresorcinate di piombo	Lead Styphnate
Trinitrotolueno	Trinitrotoluene
Trinitrotoluolo	Trinitrotoluene
Tritolite	Composition B
Triolo	Trinitrotoluene

JAPANESE TERMS

<u>Japanese Nomenclature</u>	<u>Reference in General Section</u>
Ammonyaiku	Ammonium Nitrate
Angayaku	Angayaku; also Composition B
Chakatusuyaku	Trinitrotoluene
Chanayaku	Chanayaku
Chasyaku	Chasyaku
Chikka Namari	Lead Azide
Chikkaen	Lead Azide
Ennayaku	Ennayaku
Entoyaku	Entoyaku
H2Kongo	Type 98
Haensosanbakuyaku	Type 88
Haishokuyaku	Haishokuyaku
Kaiyaku	Dynamite
Karitto	Carlit
Keyaki	Special Ammonia Gelatin (see under Dynamite)
Kiri No. 1	Ammonia Gelatin (see under Dynamite)
Kiri No. 2	Ammonia Gelatin (see under Dynamite)
Kiri No. 3	Ammonia Gelatin (see under Dynamite)
Ko-Shoan Bakuyaku	Permissible Explosive (actually, Low Density Permissible Dynamite)
L-Shoan	Permissible Explosive (actually, Low Density Permissible Dynamite)
Nigotanyaku	Composition B
Önayaku	Russian Alloy
Oshitsuyaku	Oshitsuyaku; also Composition C
Öshiyaku	Öshiyaku

JAPANESE TERMS (Cont'd)

<u>Japanese Nomenclature</u>	<u>Reference in General Section</u>
Ōshokuyaku	Picric Acid
Otsu-B	Otsu-B
Pentariru	Pentalite
Raijō	Mercuric Fulminate
Sakura No. 1	Gelatin (see under Dynamite)
Sakura No. 2	Gelatin (see under Dynamite)
Seigatta	Type 97
Shimose Bakuyaku	Picric Acid
Shin-Kiri	Ammonia Gelatin (see under Dynamite)
Shinkyoryoku	Ammonia Explosive (see under Dynamite)
Shin-Toku-Shoan	Permissible Explosive (actually, Permissible Ammonia Dynamite)
Shoan	Permissible Explosive (actually, Permissible Ammonia Dynamite)
Shoan Bakuyaku	Shoan Bakuyaku
Shoan Bakuyaku No. 104	Permissible Explosive (actually, Permissible Ammonium Nitrate Explosive)
Shoan Bakuyaku No. 201	Permissible Explosive (actually, Permissible Ammonium Nitrate Explosive)
Shoeyaku	PETN
Shotoyaku	Amatol
Shouyaku	Cyclonite
Take No. 1	Special Ammonia Gelatin (see under Dynamite)
Take No. 2	Special Ammonia Gelatin (see under Dynamite)
Take No. 3	Special Ammonia Gelatin (see under Dynamite)

JAPANESE TERMS (Cont'd)

<u>Japanese Nomenclature</u>	<u>Reference in General Section</u>
Tan-O-Yaku	Cyclonite
Toku-Shiraume No. 1	Permissible Explosive (actually, Permissible Gelatin)
Toku-Shiraume No. 2	Permissible Explosive (actually, Permissible Gelatin)
Type 1	Type I
Type 92	Type 92; also Trinitrotoluene
Type 94	Type 94

RUSSIAN TERMS

<u>Russian Nomenclature</u>	<u>Reference in General Section</u>
A	
Almatrit, Алматрит	Almatrite
Amatol Аматол	Amatol
Ammoksil Аммохсил	Ammoksil
Ammonal Аммонал	Ammonal
Аммональматрит №. 98 Аммоналматрит №. 98	Ammonalmatrit №. 98; see also Almatrit
Ammoniinaya selitra Аммонийная Селитра	Ammonium Nitrate
Ammonit Аммонит	Ammonite
Ammonit-gudronit Аммонит-гудронит	Ammonit-gudronit
Ammonprik Аммонпrik	Ammonprik
Ammontol Аммонтол	Russian Mixture
AT АТ	Amatol
Azid svintsa Азид свинца	Lead Azide
Azido-tenerossovaya Азидо-тенероссовая	Azido-tenerossovaya
Azotno-kislyi ammonii Азотно-кислый аммоний	Ammonium Nitrate
Belyaya smes' Белая смесь	Belyaya smes'

RUSSIAN TERMS (Cont'd)

<u>Russian Nomenclature</u>	<u>Reference in General Section</u>
Belit Белит	Bellite
Bezdymnyi porokh Бездымный порох	Smokeless Propellant
Bezopasnoye vzryvchatoye veshchestvo Безопасное взрывчатое вещество	Permissible Explosive
Chörnyi porokh Чёрный порох	Black Powder
Dinamit Динамит	Dynamite
Dinamon Динамон	Dynamon
Ekrazit Екразит	Ecrasite
Frantsuzskaya smes' Французская смесь	French Mixture
Gh Г	Cyclonite
Gheksoghen Гексоген	Cyclonite
Gremuchaya rtut' Гремучая ртуть	Mercuric Fulminate
Gremiche-rtutnaya Гремуче-ртутная	Gremiche-rtutnaya
Gremuchii studen' Гремучий студень	Blasting Gelatin
Grizutin Гризутин	Gelatin Dynamite

RUSSIAN TERMS (Cont'd)

<u>Russian Nomenclature</u>	<u>Reference in General Section</u>
K-1 splav К-1 сплав	K-1 Mixture
K-2 splav К-2 сплав	K-2 Mixture
Kalii Nitrat Калий нитрат	Potassium Nitrate (in Appendix I)
Kaliialmatriit No. 55 Калийалматрит № 55	Kaliialmatriit No. 55; see also Almatriit
Khlopchatobumazhnyy porokh Хлопчатобумажный порох	Guncotton
Kolloksilin Коллоксилин	Nitrocellulose
Kombinirovannaya azido-tetrilovaya Комбинированная азидо-тетриловая	Kombinirovannaya azido-tetrilovaya
Kerdit Кордит	Cordite
Krupnozernistyи Крупнозернистый	Large-grain (black powder)
Melkozernistyи Мелкозернистый	Small-grain (black powder)
Nakol'naya smes' Накольная	Nakol'naya smes'
Natriialmatriit No. 19 Натрийалматрит № 19	Natriialmatriit No. 19; see also Almatriit
Nitroglytselinovyye porokh Нитроглицериновые порох	Double-Base Smokeless Propellant; see also Propellants, Foreign
Nitroglytserin Нитроглицерин	Nitroglycerin
Nitroceliulosa Нитроцеллюлоса	Nitrocellulose

RUSSIAN TERMS (Cont'd)

<u>Russian Nomenclature</u>	<u>Reference in General Section</u>
Oksilikvit Оксиликвіт	Liquid Oxygen Explosive
Fikrit azotnia Пикріт азотній	Explosive D
Pikrinovaya kislota Нікриновая кислота	Picric Acid
Pikrinovskislyi ammonii Нікриновський аммоній	Explosive D
Pirokolloidion Пироколлоїдіон	Nitrocellulose (of 12.45% N)
Piroksilin Пироксилин	Nitrocellulose (cf 12% N or above)
Piroksilin №. 1 Пироксилин № 1	Nitrocellulose (of 12 to 13% N)
Piroksilin №. 2 Пироксилин № 2	Nitrocellulose (of 13% N and above)
Piroksilinovyye porokh Пироксилиновые порох	Singl. Base Smokeless Propellant; see also Propellants, Foreign
Plasticheskii dinamit Пластический динамит	Dynamite (plastic)
Russkaya smes' Русская смесь	Russian Mixture
Russkii splav Русский сплав	Russian Alloy
Shedit Шедіт	Cheddite
Stifnat svintsa Стифнат свинця	Lead Styphnate
Studentistyi dinamit Студентисткий динаміт	Gulatin Dynamite

RUSSIAN TERMS (Cont'd.)

<u>Russian Nomenclature</u>	<u>Reference in General Section</u>
T	Trinitrotoluene
TEN ТЭН	PETN
Tetraeritritol nitrat Тетраэритритол нитрат	PETN
Tetratsin Тетратин	Tetracene
Tetril Тетрил	Tetryl
Tetritol Тетритол	Tetrytol
TNRS THPC	Lead Styphnate
Tol Тол	Trinitrotoluene
Trinitrorezortinat svintsa Тринитрорезорцинат свинца	Lead Styphnate
Trotil Тротил	Trinitrotoluene
Vzryvchatoye veshchestvo Взрывчатое вещество	Explosive Substance (no entry in the General Section)
Zylyl (Ksilil) Ксилик	Trinitroxylene (in Appendix I)

SPANISH TERMS

<u>Spanish Nomenclature</u>	<u>Reference in General Section</u>
Aceite explosivo	Nitroglycerin
Ácido de plat.	Silver Azide
Ácido de plat.	Lead Azide
Ácido pícrico	Picric Acid
Algodón pólvora	Guncotton
Amatola	Amatol
Amonal	Amonal
Amonita	Ammonite
Astralita	Astralite
Ballistita	Ballistite
Cheddita	Cheddite
Ciclonita	Cyclonite
Cordita	Cordite
Dinamita	Dynamite
Dinamita goma	Blasting Gelatin
Ecrasita	Ecrasite
Explosivo aprobado	Permissible Explosive
Explosivo autorizado	Permissible Explosive
Explosivo de nitroglicerina	Nitroglycerin
Explosivo de seguridad	Permissible Explosive
Fulminato de mercúrio	Mercuric Fulminate
Fulminato mercúrico	Mercuric Fulminate
Gelatina detonante	Blasting Gelatin

SPANISH TERMS (Cont'd)

<u>Spanish Nomenclature</u>	<u>Reference in General Section</u>
Gelatina dinamita	Gelatin Dynamite
Gelatina explosiva	Blasting Gelatin
Hexógeno	Cyclonite
Nitrato amónico	Ammonium Nitrate
Nitroalmidon	Nitrostarch
Nitrocelulosa	Nitrocellulose
Nitrogelatina	Gelatin Dynamite
Nitroglicerina	Nitroglycerin
Nitruro de plata	Silver Azide
Nitruro de plomo	Lead Azide
Picrato amónico	Explosive D
Piroxilina	Nitrocellulose
Pólvora de base única	Single-Base Smokeless Propellant
Pólvora de doble base	Double-Base Smokeless Propellant
Pólvora negra	Black Powder
Pólvora nitrocelulósica	Single-Base Smokeless Propellant
Tetranitrometilsnilina	Tetryl
Tetryl	Tetryl
Tolita	Trinitrotoluene
Trilita	Trinitrotoluene
Trinitrofenol	Picric Acid
Trinitrotolueno	Trinitrotoluene
Trinitrotoluol	Trinitrotoluene
Trinitrostearcina plumada	Lead Styphnate
Xiloidina	Nitrostarch

IV. APPENDICES

APPENDIX I

INDEX OF EXPLOSIVES CONSTITUENTS

<u>Material</u>	<u>Uses</u>
Acardite Diphenylurea	Propellant stabilizer.
Acetone	Solvent in explosives production.
Activated Charcoal	See Charcoal.
Aluminum	Component for high explosives, primer and pyrotechnic compositions.
Ammonia	Raw material for ammonium nitrate, explosive D, ammonium chlorate, and ammonium perchlorate.
Ammonium Chloride Sal Ammoniac	Permissible gelatin dynamite component.
Ammonium Nitrate	See <u>GENERAL SECTION</u> .
Ammonium Oxalate	Permissible dynamite component, blasting explosive dehydrating agent.
Ammonium Perchlorate	Detonating composition component; oxidizer for solid rocket propellants.
Antimony Sulfide	Component in percussion primer compo- sitions.
Bagasse Pith	Absorbent in permissible explosives.
Balsa Meal	Absorbent in permissible explosives.
Barium Nitrate	Component in blasting explosives, percussion primer compositions, some propellant., and pyrotechnic compsitions.

INDEX OF EXPLOSIVES CONSTITUENTS (cont'd)

<u>Material</u>	<u>Uses</u>
Rarium Peroxide	Priming and tracer composition component.
Benzene	Raw material for nitrobenzene. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Dinitrotoluene	Incorrect reference to Dinitrotoluene (see).
Butyl Ricinoleate	Propellant deterrent coating.
Calcium Carbonate Chalk, Precipitated	Explosives stabilizer and neutralizer.
Calcium Silicide	Component in detonating and priming compositions.
Camphor	Desensitizer for blasting gelatin.
Carbazole Diphenyliimide	Propellant stabilizer.
Carbolic Acid	See Phenol.
Carbon Black	Absorbent for liquid oxygen explosives.
Caustic Soda	Ingredient in processing wood pulp or cotton linters for cellulose.
Cellulose	Raw material for nitrocellulose.
Centralite I Diethyldiphenylurea Diphenyldiethylurea Ethyl Centralite Mollite	Stabilizer and deterrent for propellants.
Centralite II Dimethyl diphenylurea Diphenyldimethylurea Methyl Centralite	Stabilizer and deterrent for propellants.
Chalk, Precipitated	See Calcium Carbonate.
Charcoal Activated Charcoal Wood Charcoal	Component for black powder and some industrial explosives.

INDEX OF EXPLOSIVES CONSTITUENTS (cont'd)

<u>Material</u>	<u>Use</u>
Chile Saltpeter	See Sodium Nitrate.
Copper Acetylide	Ignition composition for commercial electric detonators.
Cuprous Acetylide	
Cuprous Carbide	
Cornstalk Pith	Absorbent in permissible explosives.
Cotton Linters	Raw material for cellulose.
Cresol	Raw material for nitrocresols.
Cressyllite	Rarely, a component for bursting charge compositions. See also <u>GENERAL SECTION</u> .
Trinitrocresol	
Cuprous Acetylide	See Copper Acetylide.
Cuprous Carbide	See Copper Acetylide.
Dibutylphthalate	Propellant deterrent, plasticizer, and flash reducer.
Diethyldiphenylurea	See Centralite I.
Dimethyldiphenylurea	See Centralite II.
Dinitrobenzene	Industrial explosives component. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
DNB	
Dinitrochlorbenzene	Chlorate explosives component; also production of dinitrophenol, trinitroanisol, hexite. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Dinitroglycol	See Nitroglycol.
Dinitromonochlorhydrin	Low-freezing dynamite component.
Dinitrophenol	Bursting charge component (with picric acid). See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .

INDEX OF EXPLOSIVES CONSTITUENTS (cont'd)

<u>Material</u>	<u>Uses</u>
Dinitronaphthalene	Permissible explosives ingredient; rarely, component of bursting charges. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Dinitrotoluene DNT	Propellant deterrent, cooling agent, and stabilizer; component in permissible explosives, chlorate explosives, and propellants. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Dinitroxylene	Component in some non-freezing dynamites. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Diphenylamine	Propellant stabilizer.
Diphenyldiethylurea	See Centralite I.
Diphenyldimethylurea	See Centralite II.
Diphenylimide	See Carbazole.
Diphenylurea	See Acardite.
DNB	See Dinitrobenzene.
DNT	See Dinitrotoluene.
Ethanol Ethyl Alcohol	Solvent in explosives production,
Ethyl Alcohol	See Ethanol.
Ethyl Centralite	See Centralite I.
Ethyleneglycol Dinitrate	See Nitroglycerin.
Ethyl Picrate	See Trinitrophenetole.
Flowers of Tin	See Tin Dioxide.
Formaldehyde	Raw material for cyclonite.
Glass Powder	Component in percussion compositions.

INDEX OF EXPLOSIVES CONSTITUENTS (cont'd)

<u>Material</u>	<u>Uses</u>
Glycerin	Raw material for nitroglycerin.
Glycol Dinitrate	S. = Nitroglycol.
Graphite	Glaze for propellant grains; explosives binder and lubricant.
Hexamethylenetetramine	Intermediate product in the manufacture of cyclonite.
Hexamine	See Hexite.
Hexanitrodiphenyl	Detonating composition component.
Hexanitrodiphenylamine	See Hexite.
Hexanitrodiphenyloxide	Detonating composition component.
Hexanitrodiphenyl Sulfone	Detonating composition component.
Hexanitrodiphenyl Sulfide Picryl Sulfide	Component in some bursting charges and detonating compositions.
Hexanitromannite	See Mannitol Hexanitrate.
Hexanitromannitol	See Mannitol Hexanitrate.
Hexil	See Hexite.
Hexite Hexamine Hexanitrodiphenylamine Hexil	Priming composition component. See also <u>GENERAL SECTION</u> . Formerly used by Japan in some high explosive compositions.
India Salt peter	See Potassium Nitrate.
Lead Dioxide Lead Oxide Lead Peroxide	Detonating composition oxidizer.
Lead Oxide	See Lead Dioxide.
Lead Peroxide	See Lead Dioxide.
Lead Stearate	Fuel in solid rocket propellants.
Lead Sulfocyanate Lead Thiocyanate	Primer composition component.

INDEX OF EXPLOSIVES CONSTITUENTS (cont'd)

<u>Material</u>	<u>Uses</u>
Lead Thiocyanate	See Lead Sulfocyanate.
Magnesium	Component in tracer and incendiary compositions; pyrotechnic compositions.
Magnetite	Incendiary composition component.
Manganese Dioxide Manganese Peroxide Pyrolusite	Detonating composition component; pyrotechnic compositions.
Manganese Peroxide	See Manganese Dioxide.
Mannitel Hexanitrate Hexenitromannite Hexenitromannitol Nitromannite	Mercuric fulminate substitute in priming compositions. See also <u>GENERAL SECTION</u> .
Mercurous Azide Mercury Azide	Initiating composition component.
Mercury	Raw material for mercuric fulminate and mercurous azide.
Mercury Azide	See Mercurous Azide.
Methyl Centralite	See Centralite II.
Mineral Jelly Paraffin (soft) Petrolatum Petroleum Jelly Vaseline	Desensitizer and flash reducer in propellants and high explosives.
Mirbane Oil	See Mononitrobenzene
Mixed Acid Nitrating acid	Mixture of nitric and sulfuric acids, used in nitration.
Mollite	See Centralite I.
Mononitrobenzene Mirbane Oil Nitrobenzene Oil of Mirbane	Propellant and blasting explosives component. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .

INDEX OF EXPLOSIVES CONSTITUENTS (cont'd)

<u>Material</u>	<u>Uses</u>
Mononitronaphthalene	Component of some bursting charges
Nitronaphthalene	(with picric acid). See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Mononitrotoluene	Component in low-freezing dynamites, blasting explosives, as a plasticizer. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Naphthalene	Raw material for nitronaphthalenes. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Nitrate of Potash	See Potassium Nitrate.
Nitrating Acid	See Mixed Acid.
Nitric Acid	Raw material used in the production of explosives (usually in mixed acid).
Nitrobenzene	See Mononitrobenzene.
Nitroglycol	Component in permissible explosives and low-freezing dynamites.
Dinitroglycol	
Ethyleneglycol Dinitrate	
Glycol Dinitrate	
Nitromannite	See Mannitol Hexanitrate.
Nitromethane	See Tetranitromethane.
Nitronaphthalene	See Mononitronaphthalene.
Nitrosoguanidine	Component in percussion priming compositions.
Oil of Mirbane	See Mononitrobenzene.
Paraffin	See Mineral Jelly.
Perchlorate of Potash	See Potassium Perchlorate.
Perfluorourea	Oxidizer in solid rocket propellants.

INDEX OF EXPLOSIVES CONSTITUENTS (cont'd)

<u>Material</u>	<u>Uses</u>
Petrolatum	See Mineral Jelly.
Petroleum Jelly	See Mineral Jelly.
Petroleum Oil	Explosives binding agent.
Phenol	Raw material for nitrophenols. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Carbolic Acid	
Phthalates	Fuels in solid rocket propellants.
Picryl Sulfide	See Hexanitrodiphenyl Sulfide.
Polypertrinacrylate	Oxidizer in solid rocket propellants.
Polysulfide Rubber	See Thickol Polymer.
Polyurethanes	Fuels in solid rocket propellants.
Potassium Chlorate	Oxidizer for priming compositions.
Potassium Nitrate	Component in black powder and pyrotechnic compositions; oxidizer in solid rocket propellants.
India Saltpeter	
Nitrate of Potash	
Prismatic Saltpeter	
Saltpeter	
Potassium Perchlorate	Component for primer compositions, chlorate explosives, and pyrotechnic compositions; oxidizer in solid rocket propellants.
Perchlorate of Potash	
Potassium Sulfate	Primer composition component.
Prismatic Saltpeter	See Potassium Nitrate.
Pyrolusite	See Manganese Dioxide.
Soda Ash	Ingredient in processing wood pulp or cotton linters for cellulose.
Sal Ammoniac	See Ammonium Chloride

INDEX OF EXPLOSIVES CONSTITUENTS (cont'd)

Material	Uses
Salt	See Sodium Chloride.
Saltpeter	See Potassium Nitrate, Sodium Nitrate.
Saltpeter, Chile	See Sodium Nitrate.
Saltpeter, Prismatic	See Potassium Nitrate.
Silver Acetylide	Detonating composition component.
Silver Permanganate	Primer composition component.
Sodium Bicarbonate	Blasting explosives cooling agent.
Sodium Chlorate	Explosives and pyrotechnic composition oxidizer.
Sodium Chloride Salt	Permissible explosives briance reducer.
Sodium Hyposulfite	See Sodium Thiosulfate.
Sodium Nitrate Chile Saltpeter Saltpeter	Component in black powder, blasting powder, permissible explosives, ammonia dynamites, and pyrotechnic compositions; oxidizer in solid rocket propellants.
Stannic Oxide	See Tin Dioxide.
Strontium Dioxide Strontium Peroxide	Component in tracer and other pyrotechnic compositions.
Strontium Peroxide	See Strontium Dioxide.
Sugar	See <u>GENERAL SECTION</u> under <u>Sugar Nitrates</u> .
Sulfur	Component in black powder, some dynamites, pyrotechnic compositions; raw material for sulfuric acid.
Sulfuric Acid	Component of mixed acid used for explosives production.
Tetranitromethane	Component in detonating composition and blasting explosives.

INDEX OF EXPLOSIVES CONSTITUENTS (cont'd)

<u>Material</u>	<u>Uses</u>
Thiokol Polymer Polysulfide Rubber	Fuel in solid rocket propellants.
Tin	Propellant flash reducer.
Tin Dioxide Flowers of Tin Stannic Oxide	Propellant flash reducer.
TNB	See Trinitrobenzene.
TNN	See Trinitronaphthalene.
TNX	See Trinitroxylene.
Toluene	Raw material for nitrotoluenes. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Trinitroanisol	Booster charge component. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Trinitrobenzene TNB	Most powerful of the aromatic nitro compounds, but too difficult to prepare except indirectly from TNT, which makes its production infeasible. It can be used as a high explosive.
Trinitroceresol	See Cressylite.
Trinitronaphthalene TNN	Stabilizer for smokeless propellants. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Trinitrophenol Ethyl Picrate Trinitrophenylethylether	Booster and bursting charge component. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Trinitrophenylethylether	See Trinitrophenol.

INDEX OF EXPLOSIVES CONSTITUENTS (cont'd)

<u>Material</u>	<u>Uses</u>
Trinitroxylenes TNT	Component in bursting charges (with TNT and ammonium nitrate). See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .
Vaseline	See Mineral Jelly.
Vegetable Meal	See Bagasse Pith; Balsa Meal, Cornstalk Pith.
Wood Charcoal	See Charcoal.
Wood Pulp	Absorbent for nitroglycerin in dynamites; raw material for cellulose.
Xylene	Raw material for nitroxylenes. See also <u>GENERAL SECTION</u> under <u>Aromatic Nitro Compounds</u> .

APPENDIX II
 COMPARATIVE TEST VALUES OF SELECTED EXPLOSIVES

Explosive	Impact Sensitivity		Brittleness		Cover:	Ballistic Test, 200-22 Barsh Apparatus*	Tensile Test Mortar: TNT	Net weight, secound @ density (lb/in.)	Iguration Rate
	B.I.	P.A.	Sand Test, 200-22 Barsh Apparatus**	Ges of sand					
Ametol 80/20	90	15	35.5	130	123	4,500 ± 10% (depending upon density of explosive)			
Ametol 60/40	95	16	11.5	128	***	5,750 ± 1.50			
Ametol 50/50	95	16	12.5	124	***	5,430 ± 1.55			
Amesal	72	11	47.8	***	***				
Ammonium nitrate	110*	31	n/a	***	56	1,000 ± 0.5 (solid, no confinement); 2,500 ± 1.4 (Liquid, strong confinement)			
Baratol	35	11	26.8	***	***				
Baronol	30	14	39.8	96	***	5,150 ± 2.32			
Black Powder	32	16	8	50	10	410 ± 1.6			
Elastiting Gelatine	***	***	***	20	***				
Compositions &	***	***	49.6	130	144	***			
Composition A-3	100*	16	51.5	135	***	9,100 ± 1.55			

* Press of mines Apparatus.
 ** Prismatic Arsenic Apparatus.

APPENDIX II (continued)

Explosive	Distant Sensitivity 3 in. P.A.	Apparatus 2-kg wgt., 2-kg wgt., hgt. in cm	Brittleness Sand Blast, 200-gm Bomb gms of tank	Detonation Rate		
				TNT	TNT	Power Ballistic Mortar
Cyclotol B	75	14	54.0	13.3	1.10	7,810 ± 1.68
Cyclotol C	100*	...	46.5	120	...	...
Cyclotol C-2	90	...	47.5	126	...	7,660 ± 1.57
Cyclotol C-3	100*	14	53.1	125	1.7	7,625 ± 1.60
Cyclotol C-4	100*	19	55.0	130	...	9,010 ± 1.59
Cyclonite	32	8	60.2	150	1.7	8,180 ± 1.65
Cyclotol 75/25	...	...	...	...	...	7,928 ± 1.72
Cyclotol 70/30	60	14	56.6	135	...	8,035 ± 1.70
Cyclotol 65/35	...	...	55.4	134	...	8,066 ± 1.73
Cyclotol 60/40	75	14	54.6	133	...	1,975 ± 1.72
NNA	35	13	58.5	146	...	7,930 ± 1.72
HNP	...	4, 7*	47.5, 45.5*	...	...	6,600 ± 1.65
					77	4,400 ± 0.9
						6,600 ± 1.5
						6,900 ± 1.5

* Test 11. At 10' established which layer of picramic acid is involved.

APPENDIX II (continued)

Explosive	Impact Sensitivity		Resistance		Power	Detonation Rate
	B.M.	P.I.	Sand Test,	Mortar		
Apparatus	Apparatus	200-lb. Bomb	2 lb.	% TNT	metres/second & density (gm/cc)	
200-lb. Mortar bgt. in 30 hgt. in 10 in.						
Tetryl	100+	9	42.2	90	77	6,760 ± 1.38
Explosite w/ Inertia Base	***	***	***	***	114	***
(75% Guncat Dynamite)						
Z. C. Powder	19	***	16.8	***	***	***
Alma	48	14	52.5	2.59	122	***
Eduard's 6Q40	***	***	48.0	119	114	***
Baratol 55/45	95	***	49.1	119	120	7,340 ± 1.62
Explosive D	***	17	39.5	99	***	6,850 ± 1.55
Gelatin Dynamite, 65%	***	***	***	***	114	***
Benzite	***	***	114.0	105	105	***
Benzite-Almidite	***	***	114.0	130	116	***
T.T. (Beta-alicyclic)	12	9	60.4	150	115	9,124 ± 1.82
RUBER	***	3	130.6-144.8	***	***	***
L.E.E.	30*	***	21)	***	***	***

* 1-log weight.

APPENDIX II (continued)

<u>Explosive</u>	<u>Impact Sensitivity</u>	<u>Brisance</u>	<u>Power</u>	<u>Detonation Rate</u>
B.I.A.	P.A.	Sand Test, 200-lb. Bomb	Tranx Test Mortar 1 lb.	Meters/second @ density (lb./cc.)
Lod. azide	10 (pure) 17 (cartri- nated)	3 (pure) 5 (decartri- nated)	19.0 24	3.7 1.0
Lead Styphnate	1.7	3	•••	5,200 ± 2.0
Low Velocity Military Energetics	•••	29	92	4,357 ± 0.9
Munition Hexanitrate	11	4	63.5	1.72
Medium Velocity Military Dynamite	100	18	52.6	8,260 ± 1.73
Mercuric Fulminate	5	2	23.4	6,900-6,630 ± 1.1
Nitro	35	13	•••	3,500 ± 2.0
Nitronal® Nitro (2,6-NI)	8	3	45.0	4,250 ± 2.0
Nitrocellulose (23.45%)	9	3	49.0	5,000 ± 4.0
Nitroglycerin (Liquid)	15	•••	51.5	5,300 ± 1.68
			163	5,300 ± 1.68
			165	•••
			•••	•••
			1.25	7,300 ± 1.20
			1.40	1,600-1,900 ± 1.4 (gives octane test)
			1.61	7,700 ± 1.6 (silver confirmation)

APPENDIX II (continued)

Test Article	Impact Sensitivity		Brittleness		Power		Detonation Rate Enter, second in deton. (sec.)
	B.I. P.A.	Apparatus: 2-lb weight, 2-lb weight, lgt. in cu. in. wgt. in lb.	Sand Test, 200-gr. Bomb gns of sand	Ballistic Mortar 3 lb	Tranit Test 3 lb		
Barogardine	47	26	36.0	104	101	1,550 ± 1.55	
Nitrostarch Residue	21	8	39.5	96	...	...
Pentolite 54/50 Explosive	34	12	55.6	126	122	7,470 ± 1.67	
Pentolite 10/90	65	24	19.5	...	...	7,440 ± 1.66	
PER	17	6	62.7	115	173	8,300 ± 1.75	
Pentolite 52/48	300+	17	15.0	190	...	6,970 ± 1.13	
Picric Acid	85	13	18.5	112	101	5,200 ± 1.64 (preseed) 7,300 ± 1.71 (bare)	
PPG	...	11	11.6	...	...	7,050 ± 1.37	
PL-10	100+	...	8.1	134	(127)*	6,210 ± 1.11	
PLX-95/5	100+	...	50.6	...	...	6,165 ± 1.12	
PTI-1	44	...	34.8	132	...	7,655 ± 1.64	
PTI-2	35	...	36.9	133	...	6,065 ± 1.70	

* P Picric Acid.

APPENDIX II (continued)

Explosive	Impact Sensitivity		Briseance Sand Test, I.A.	Sensitivity Apparatus / 2-kg wgt., het in cm let in 1 in.	Power Sensitivity Mortar % TNT	Detonation Rate Trenz Test % TNT	Detonation Rate meters/second @ density (gm/cc)
	3.M.	T.P.E.					
25. 4	39	9	18.5	***	***	7,915 @ 1.60	
RDX	53	15	10.1	116	***	7,390 @ 1.37	
Silver Arids	5	3	18.9	***	(63)*	***	
TNT	100+	43	14.7	***	***	***	
Tetrazene	7	2	28.0	***	51	***	
TNT, f.	26	8	14.2	130	125	7,350 @ 1.71	
Tetrytol 80/20	28	9	14.0	***	***	***	
Tetrytol 75/25	28	10	13.7	122	***	7,385 @ 1.61	
Tetrytol 70/30	23	11	15.2	120	***	7,340 @ 1.60	
Tetrytol 65/35	29	11	12.6	***	***	7,210 @ 1.60	
Tetrytol	12	9	15.5	138	164	7,405 @ 1.81	
Acidoborane	25	***	***	(90)**	***	***	
Tetrytol	***	***	36.0-43.0	90-100	91-102	***	

* X Hg(18C) 2°
** X PETN.

APPENDIX III (continued)

<u>Explosive</u>	<u>Impact Sensitivity</u>		<u>Briescence</u>		<u>Power</u>	<u>Detonation Rate</u>
	<u>B.N.</u>	<u>P.A.</u>	<u>Sand Test,</u>	<u>Ballistic</u>		
<u>Apparatus</u>	<u>Apparatus</u>	<u>200-in. Bomb</u>	<u>Mortar</u>	<u>% TNT</u>	<u>% TNT</u>	<u>inches/second & density (gm/cc)</u>
		<u>gms of sand</u>				
Trinitroite	60	10	44.2	...	...	7.620 ± 1.610
Trinitrotoluene	95-100	14-15	48.0	Std-100	Std-100	6,640 ± 1.55 (cast) 6,825 ± 1.56 (pressed)
Trinitrocellulose	85	13	52.0	124	125	6,675 ± 1.71 (cast) 6,700 ± 1.72 (pressed)
Type 98	...	...	44.0	109	109	...

BIBLIOGRAPHY

Aberdeen Proving Ground, Aberdeen, Maryland, the Ordnance School.
Fundamentals of Explosives, U.S. and Foreign, ST 9-2900-1.
January 1953.

Bebie, Jules. Manual of Explosives, Military Pyrotechnics, and Chemical Warfare Agents. New York: The Macmillan Company, 1943.

Brady, George S. Materials Handbook. 7th edition. New York:
McGraw-hill Book Company, Inc., 1951.

Brunswig, H. Explosives. Translated and annotated by
Charles E. Monroe and Alton L. Kibler. 1st edition. New York:
John Wiley and Sons, 1912.

Castilla's Spanish and English Technical Dictionary. 2 Volumes.
New York: Philosophical Library, 1958.

Chernukin, Adolph E., editor. The English-Russian Technical Dictionary. Moscow: The State Theoretical Publishing House, 1934.

Cchen, Jerome S. Japan's Economy in War and Reconstruction.
Minneapolis: University of Minnesota Press, 1949.

Colver, Edward. High Explosives. New York: D. Van Nostrand
Company, 1918.

Combined Intelligence Objectives Subcommittee. German Practice
and Experience in Filling High Explosives. Item No. 2,
File No. XXVIII-60.

Cook, Melvin A. The Science of High Explosives. New York:
Reinhold Publishing Corporation 1950.

Davis, Tenney Lombard. The Chemistry of Powder and Explosives.
2 volumes. New York: John Wiley and Sons, Inc., 1941, 1953.

De Vries, Louis. English-German Technical and Engineering
Dictionary. 1st edition. New York: McGraw-Hill Company,
Inc., 1954.

Denti, Renzo. Italian-English English-Italian Technical Dictionary.
2nd edition. Milan: Uirico Hoepli Publisher, 1951.

Duke University, Durham, North Carolina, Ordnance Engineering
Handbook Office. Glossary of Ordnance Terms. Preliminary edition.
W. W. Holler, editor, June 1959.

Kettridge, Julius C. French-English and English-French Dictionary
of Technical Terms and Phrases. New York: The Wilson Company,
E. d.

- Bibliography
- Marchand, Arthur. Dictionary of Explosives. Philadelphia: P. Blaikie & Son and Company, 1920.
- Meyer, J. L. The Science of Explosives: An Introduction to Their Composition, Manufacture, and Analysis. New York: The Crowell Co., 1935.
- Moder, C. A. Handbook of Military Explosives. Lecture in the Ammunition Training Bureau, Picatinny Arsenal. Ordnance Corps, 21 October 1944.
- Naoum, Dr. P. Nitroglycerine and Nitroglycerin Explosives. Translated by M. Symmes. Baltimore: The Williams & Wilkins Company, 1928.
- North Atlantic Treaty Organization, Military Agency for Standardization. Specification for Ammonium Nitrate (for Explosives). No. 4624, 2, October 1958.
- Olsen, Allen. Explosives Crayon. New York: John Wiley and Sons, 1944.
- Picatinny Arsenal Laboratory, W. R. Tomlinson, Revision 1, Properties of Explosives of Military Interest. Revised by O. E. Sheffield. Report No. 2958, February 1958.
- Picatinny Arsenal Laboratories (German Sect.), and E. F. Reiss, A Dictionary of Explosives, Ammunition, and Weapons, B. T. Fedoroff, V. A. Aronson, (Eds.), D. Clift, E. F. Roese, and W. A. Anderson. Report No. 2510, January 1958.
- Picatinny Arsenal Laboratories, B. T. Fedoroff, Report No. 2510, A Dictionary of Russian Ammunition and Weapons, D. Clift, E. F. Roese, and W. A. Anderson. February 1955. CONFIDENTIAL.
- Picatinny Arsenal, Aeroplane Ammunition and Explosives. Dover, New Jersey, 1944.
- Robinson, G. H. Shove. Explosions -- Their Analysis and Destruction. 1st edition. New York: McGraw-Hill Book Company, 1944.
- Smith, C. H. Alton. TNT -- Trinitrotoluenes and Monobenzyl Nitro Compounds -- Their Manufacture and Properties. New York: D. Van Nostrand Company, 1918.



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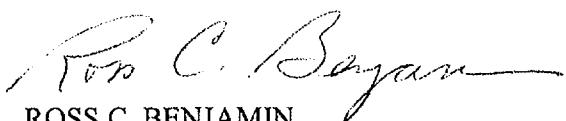
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ROSS C. BENJAMIN
Director, Energetics, Warheads
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3. Any questions please contact the undersigned at (973) 724-4287 or
ross.benjamin@us.army.mil.

A handwritten signature in black ink, appearing to read "Ross C. Benjamin".
ROSS C. BENJAMIN
Director, Energetics, Warheads
& Manufacturing Technology
Directorate, METC